PRACTICAL ENGINEER

Trade-mark reg. U. S. Pat. Office

SEMI-MONTHLY

VOL. XIX. CHICAGO, AUGUST 15, 1915 No. 16

Power for Tanning

SMALL BUT WELL EQUIPPED PLANT OF THE BARNET LEATHER CO., AT LITTLE FALLS, N. Y., GIVING GOOD SERVICE; UNIQUE METHOD OF ASH DISPOSAL; BLEEDER TURBINE SUPPLIES STEAM FOR MANUFACTURING AND HEATING PURPOSES

ONE OF THE MOST modern, most completely equipped and most efficiently and economically operated isolated power plants used for the generation of light, heat and power is that of the Barnet Leather Co. of Little Falls, N. Y.

The building used to house this power generating equipment is of steel, concrete and brick construction, having an overall length of approximately 93 ft. and a width of 45 ft., and is so situated as to be entirely separate from any of the other buildings of the tannery. A 16-in. brick party wall divides the building into 2 sections, one of which is employed as the boiler house while the other is given over to the turbines and their auxiliary equipment. As may be seen by referring to Fig. 2, the floor of the boiler room is on the ground level while that of the turbine room is at an elevation of 8 ft. above this, with the basement floor of the turbine room 5 ft. below that of the boiler room.

Large windows in both boiler and turbine rooms provide excellent illumination throughout the hours of daylight.

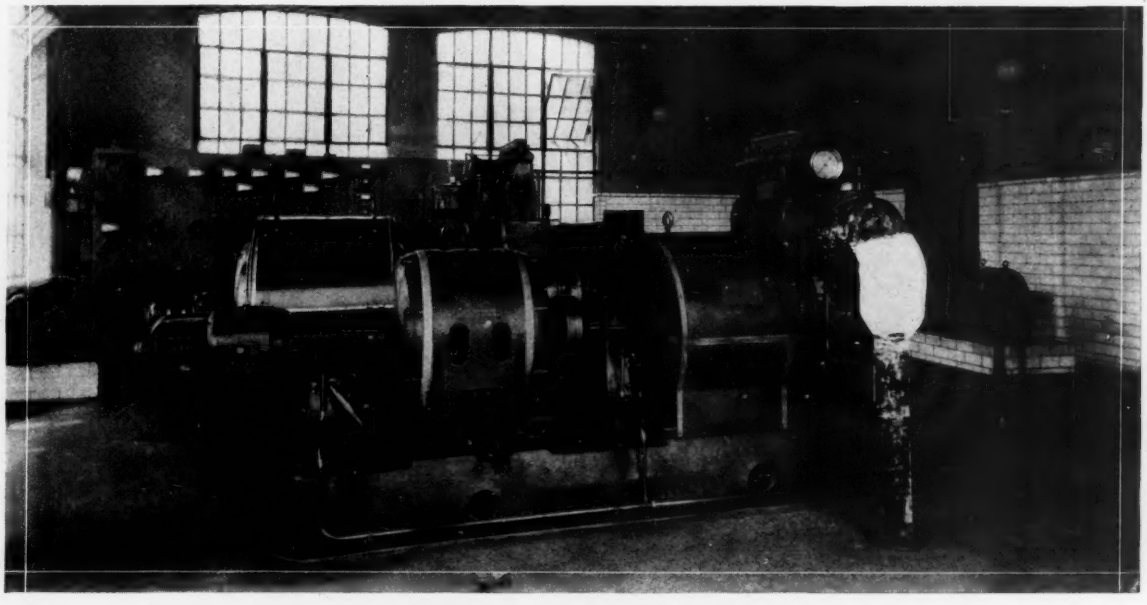


FIG. 1. GENERAL VIEW OF TURBINE ROOM

BOILER ROOM

ANTHRACITE SCREENINGS is the form of fuel used. This is delivered by wagon to the plant and is dumped into a concrete pit located directly outside and at one end of the boiler room. From this pit it is conveyed by means of a bucket conveyor and elevator to steel-concrete bunkers above the boilers, from where it is fed through the tops of the furnaces into Murphy stokers. Figure 3 shows the fronts of the furnaces, while in Fig. 4 is illustrated the tops of these same furnaces, the coal chutes and some of the piping.

An interesting and somewhat uncommon feature of this plant is the method of ash disposal employed. While the basic principles of this system, which is that employing the steam jet, have been and are being applied in many plants, there are in this particular installation a number of details which warrant at least a brief description.

In Fig. 5 is shown a plan and elevation of a general outline of the piping and connections used. As shown in this illustration, an iron pipe of sufficient capacity is placed along the fronts of the furnaces below the level of the floor of the ash pits, each of which has 2 square opening of about 6 by 6 in., leading into this pipe. When not in use, these openings are kept closed by cast-iron cover plates. The ash discharge pipe is carried underground until it reaches one corner of the boiler room, where, by means of a 90-deg. elbow, it is led upward so as to discharge into one end of the coal bunker which is, of course, separated from the larger section used for the storage of coal by means of a suitable partition.

A 1¼-in. steam line connected to high-pressure header is carried along the fronts of the furnaces, then downward and below the level of the floor up to the elbow in the ash discharge pipe, where it enters this fitting, pointing in an upward direction.

To remove the ashes, the operator opens a valve placed on that section of the steam supply line, which runs along the fronts of the furnaces and allows a flow of steam into the ash disposal pipe in a direction leading to the ash bunker. He then removes the cover plates of that ash pit at which he is working and by means of a hoe draws all the ashes and refuse forward over the openings leading into the ash disposal pipe. The partial vacuum caused by the flow of steam at the extreme end of the horizontal

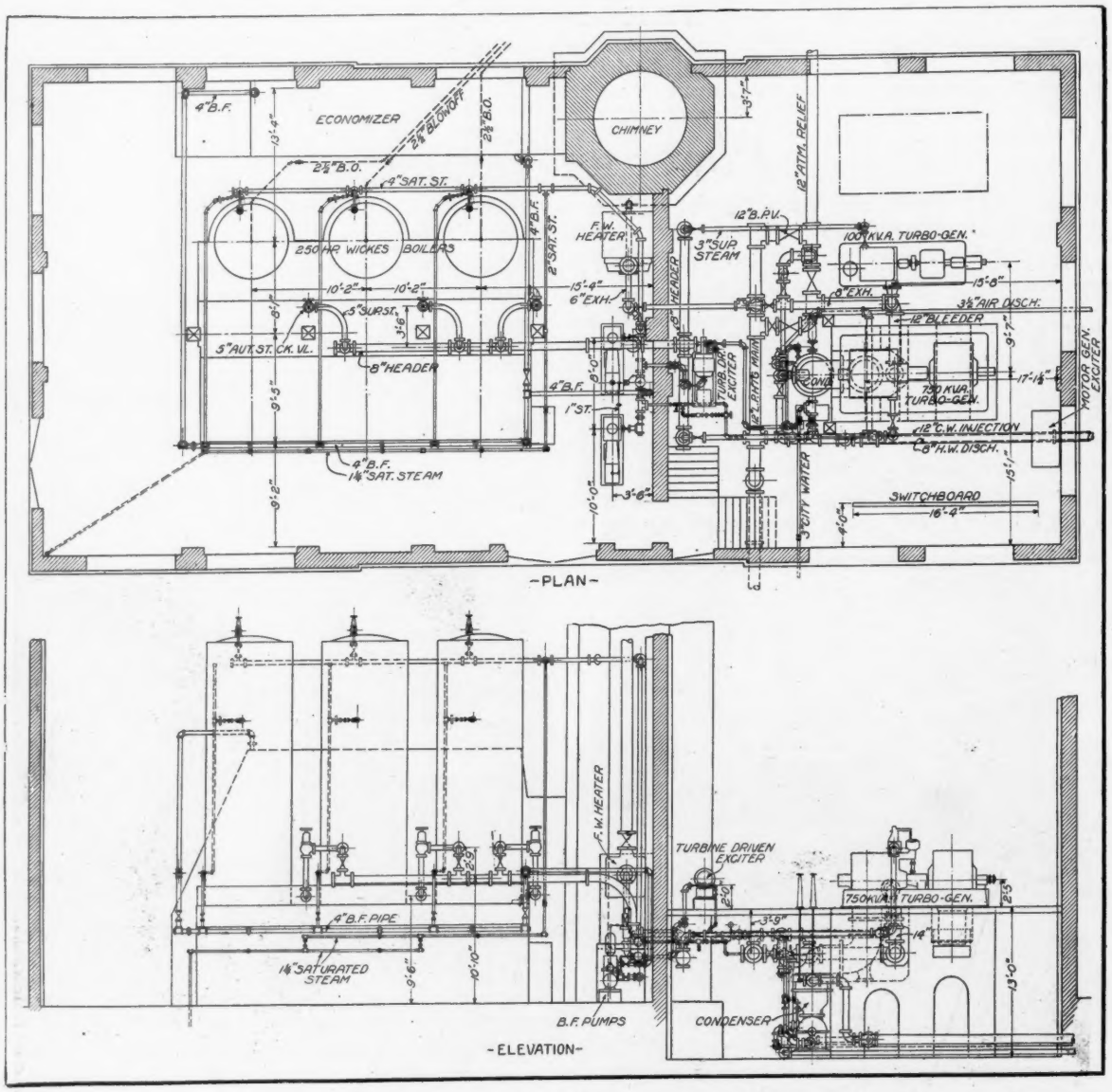


FIG. 2. PLAN AND ELEVATION OF BARNET LEATHER CO.'S PLANT

section of this pipe causes the ashes not only to be drawn into the pipe up to the steam jet, but upon striking this jet they are forced at a high velocity upward and deposited in the bunker above. From this point, they are

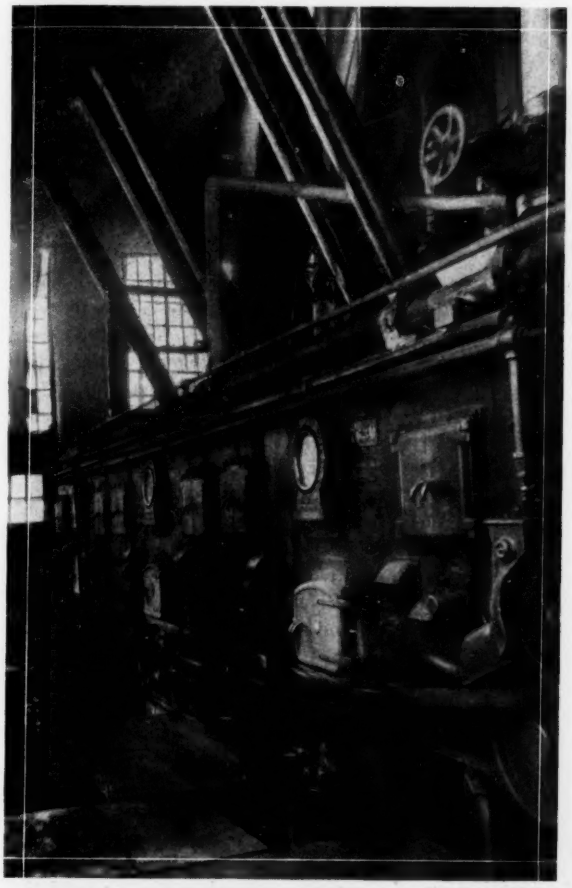


FIG. 3. FRONTS OF FURNACES ALONG FIRING AISLE

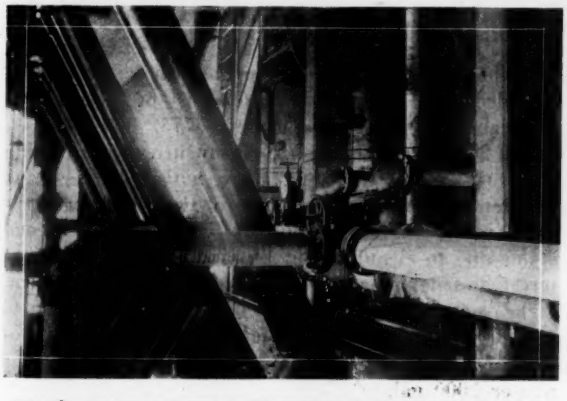


FIG. 4. TOPS OF FURNACES SHOWING COAL CHUTES AND PIPING

discharged into wagons by means of chutes passing through the building walls.

Water obtained from the Mohawk River is, by means of electrically operated pumps, pumped into 2 large overhead tanks from which it flows into a Cochrane open heater, the flow of water being regulated by a float valve in the heater. After being heated to as high a temperature as it is possible to obtain, it is pumped by either one of 2 M. T. Davidson simplex steam pumps into and through the coils of a Sturtevant economizer, thence into whichever of the 3 250-hp. Wickes water-tube boilers may be in service.

Steam which is ordinarily generated at a pressure of 160 lb. gage is passed through Foster superheaters before being delivered to the turbines, to which it is carried

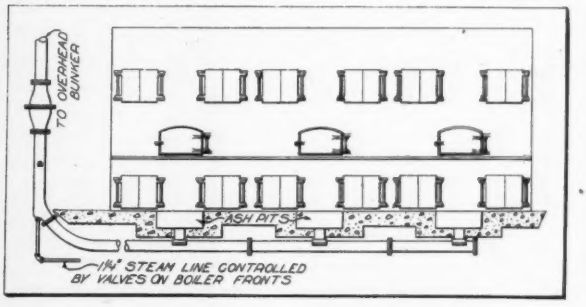


FIG. 5. DIAGRAM OF ASH DISPOSAL SYSTEM

through an 8-in. extra heavy header, running along the top of the furnaces in the boiler room and under the floor in the engine room.

After coming from the economizer, the 4-in. boiler feed line runs directly in front of the furnaces with a 2-in. branch controlled by a globe valve leading to each boiler.

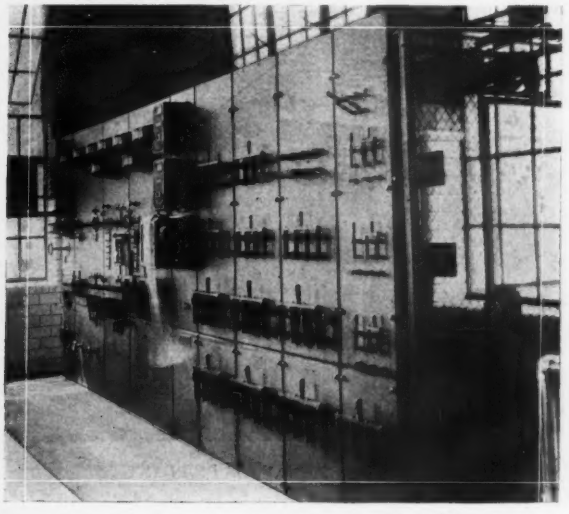


FIG. 6. GENERAL VIEW OF SWITCHBOARD

Each boiler is equipped with a General Electric indicating flow meter so that the operator may be able to tell at a glance how the load is proportioned among the various units.

Prime Movers

These consist of 1 750-kv.a. 240-v. G. E. turbo-alternator equipped with a Westinghouse Leblanc condenser and 1 100-kv.a. 240-v. G. E. noncondensing turbo alternator, both of which sets deliver 2-phase, 60-cycle current.

Considerable low-pressure steam is called for in the tanning process and also for heating purposes during the winter months, and to supply this demand it is necessary to resort either to the use of live steam or the exhaust of the smaller turbine. The continuous use of live steam is not advisable, and with heavy loads it becomes necessary to operate the large or condensing unit instead of the smaller set, 2 conditions detrimental to the proper supply of steam outside of the plant. To overcome this state of affairs and insure a positive and continuous supply of steam for manufacturing and heating purposes, a 12-in. bleeder is taken off from the large turbine and connects directly with the exhaust from the 100-kv.a. set onto the 12-in. low-pressure main as may be seen in Fig. 2.

FIG. 7. GENERAL VIEW OF PLANT

Field excitation for the small set is obtained from a direct connected exciter, while for the 750-kv.a. unit 2 separately driven exciters have been installed. One of these is a 7.5-kw. machine driven by and direct connected to a Kerr noncondensing steam turbine, while the other is a motor generator set built up of a 14-kw. direct-current generator and a 2-phase induction motor.

The switchboard, as shown in Fig. 6, is of black slate construction, having the regulation generator, feeder and totalizing panels with Tirrill voltage regulator, synchronism indicator, one totalizing curve drawing wattmeter and the necessary voltmeters, ammeters and knife switches.

Saving by Water Softening

AT the close of a paper on station operation read before the N. D. H. A. convention, conditions were stated which have resulted in the decision to soften the water in New York City for a given power plant, where the incrusting solids are only 2.8 grains per gallon, the plant being of capacity to handle 80,000 gal. an hour, equivalent to 20,000 boiler horsepower. Of the incrusting solids, it is found that some 20 per cent will form a hard crystalline scale. The boilers are to be fired with bituminous coal, burned on stokers, and with a load from 125 to 250 per cent rated capacity. These conditions would result in the formation of hard scale, which would require rather frequent turbining, and the scale formed would be very difficult to remove, since it takes on the characteristics of a white enamel.

Firing under the conditions of 70 per cent rating, a plant of 17,000 boiler horsepower would be required to get 12,000 hp. output. Using the stokers, and treating the water so that the boilers can be forced, the 12,000 hp. output can be obtained from 9000 rated horsepower. A peak load of 22,500 hp. can be delivered from the installation. Running at 12,000 hp., 24 hr. a day, and 30 days a month, there would be deposited from this water 27,423 lb. of incrusting matter, which on 90,000 sq. ft. of heating surface, would produce a scale ¼ in. thick, which would not be uniform, but would be much thicker in the lower tubes than in the higher ones. It is estimated that the cost of removing this scale every 30 days by means of cleaners would be $10,800 a year, and the installation of the water softening plant would cost approximately $20,000, and would render unnecessary any use of tube cleaners. It is figured that with 10 per cent interest and depreciation, 4 hr. labor a day for care of the softening system, and a chemical cost of $2073, the total operating cost in the year will be $5025, which deducted from the $10,800, cost of cleaning by tube cleaners, give a net saving of $5775, somewhat better than 25 per cent on the investment in water softening apparatus, and in addition, there will be a lessening of the renewals of tubes, bettering of the efficiency of the boiler heating surface, saving of the time out of commission due to cleaning and repairs, and the saving of interest and depreciation on a larger boiler investment.

The softener plant is expected to deliver water to the boilers with an average maximum of ½ grain of incrustants per gallon, at a chemical cost of 0.6 of a cent per 1000 gal.

The need of making sure that the indications of station instruments, gages and thermometers are correct was brought out by the citing of 2 instances, where inaccuracy in such instruments resulted in maintaining wrong or inefficient operating conditions, and the correction of the measuring instruments brought about satisfactory systems of operation, at a considerable saving.

Rudimentary Economics of Steam Engine Operation

EFFECTS OF CHANGE OF INITIAL PRESSURE, POINTS OF CUTOFF, BACK PRESSURE AND VACUUM UPON STEAM CONSUMPTION. BY REGINALD TRAUTSCHOLD

A SCORE of years ago, the average steam pressure (gage) employed in reciprocating engine practice was about 80 lb. per sq. in.; while today, the use of steam at 200 lb. pressure is not at all uncommon. During this same period, engine design and construction have also improved, it is true, but the most striking difference has been in the steam pressure employed. The sole object of the change has been to improve the economy in steam consumption, increase the efficiency of the engine—in other words, to permit an earlier cutoff while developing the same indicated power output. The monetary gain is measured in the reduction in the rate of fuel consumption, of course, and, though this has been quite appreciable, it cannot be measured directly in terms of increased steam pressures.

A modern engine operating on 200 lb. steam cutoff at 12 per cent of stroke, would have an average pressure of some 65 lb. per sq. in. exerted on its piston throughout the working stroke, representing the mean effective pressure should there be no back pressure. A similar engine operating under identical conditions of exhaust, etc., but with initial steam pressure of but 80 lb. per sq. in., would require the cutoff to take place as late as 49 per cent of stroke in order to develop the same indicated power output; i.e., have the same mean effective pressure exerted on its piston. The foregoing is taken from Fig. 1, the curves of which are plotted from the data of Table I, values obtained from careful measurement of various typical indicator cards. This would mean that the volume of steam employed in the low pressure engine would be, at its initial pressure, 4½ times as great as that of the higher pressure steam employed when under its initial pressure. The difference in economy of steam consumption of the 2 engines would not be anything like 4 to 1, however, as the 200-lb. steam is considerably the heavier and requires more heat for its generation. The actual gain, reduction in fuel consumption, per indicated power output would be about 53⅓ per cent. In developed power output, the gain would be somewhat less, for the higher the initial steam pressure and the earlier the cutoff, the greater the discrepancy between the indicated and developed power output of a reciprocating steam engine. A gain in the neighborhood of 50 per cent may then safely be taken as about the measure of 20 yr. progress in efforts to reduce the rate of steam consumption.

TABLE I. AVERAGE PRESSURES ON PISTON AT VARIOUS GAGE PRESSURES AND CUTOFFS

Cutoffs Per cent stroke	Steam Pressure—Lb. per sq. in.—Gage 80	100	125	150	175	200
10	16.5	23.2	31.5	40.0	48.5	56.3
15	26.5	35.1	45.7	56.5	67.5	78.0
20	34.7	45.0	58.3	71.0	84.5	97.0
25	41.7	53.5	68.8	83.0	98.5	113.5
30	47.9	61.1	77.7	94.3	111.0	127.8
35	53.3	67.5	86.0	103.5	121.5	139.5
40	57.5	73.0	92.4	111.5	130.5	149.5
45	61.8	78.0	98.3	119.0	138.5	158.0
50	65.5	82.5	103.5	125.0	146.5	167.5

This improvement is chargeable primarily and almost solely to clearer understanding of fundamental principles of engine operation. Simple as are these principles, it is the practical man who fails to realize how much his own advancement and success depend upon his clear conception of what actually happens in the engine cylinder and his ability to make logical suggestions of ways and means for improving steam consumption.

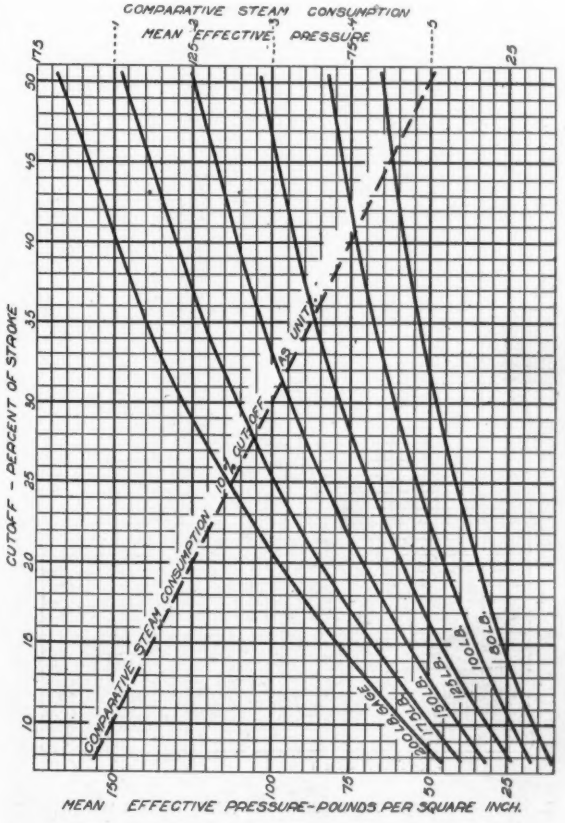


FIG. 1. MEAN EFFECTIVE PRESSURES AT VARIOUS INITIAL PRESSURES AND CUTOFFS, BACK PRESSURE 0 LB. GAGE

In order that comparisons may be general and conditions not too dissimilar from those encountered in present day practice, economies gained by increasing the initial steam pressure from 125 lb. per sq. in. to 150 lb. may better be considered than those accruing in the change in average practice that has come about in 20 yr. With steam under initial pressures of 125 and 150 lb. per sq. in., similar mean effective pressures, disregarding entirely any back pressure or assistance from the use of a condenser, would be developed with cutoffs occurring at 19 and 15 per cent of stroke respectively, see

Fig. 1. The steam at the higher pressure would occupy but 79 per cent of the space required for the 125 lb. steam, but would weigh about 21½ per cent more for a given volume; reduced to similar conditions, about 4 per cent less steam would be required to develop the same indicated power when using the 150-lb. steam with the earlier point of cutoff. The net saving in heat required for the generation of the necessary steam of the 2 pressures would favor the 150-lb. steam by only about 22 B.t.u., however (see Steam Tables), so that, if the engines developed, on the average, some 150 i.hp. during a 10-hr. working day, the net saving in coal would be a ton every 6 or 7 weeks, assuming a heat value for the coal of 12,500 B.t.u. per lb.

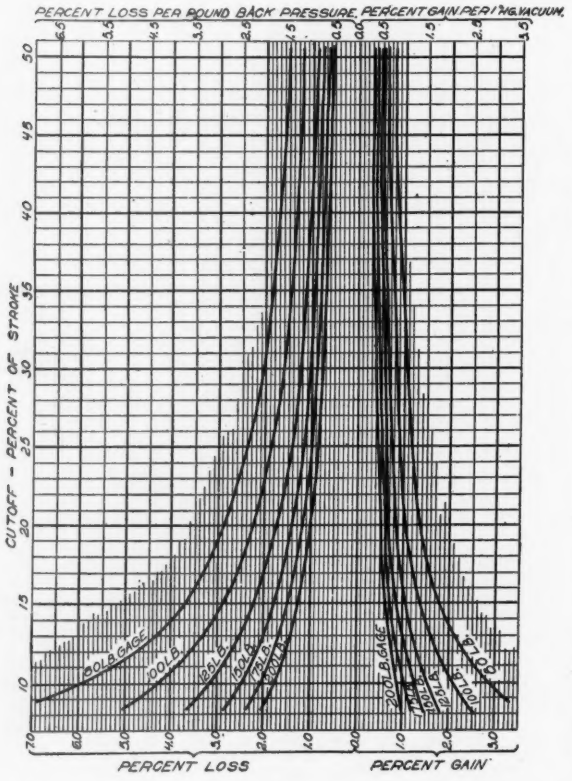


FIG. 2. LOSS DUE TO BACK PRESSURE AND GAIN DUE TO CONDENSER VACUUM, TYPICAL RECIPROCATING STEAM ENGINES

The steam consumption of any engine, irrespective of the initial pressure of the steam, being dependent upon the position of cutoff, the comparative steam consumption varies very nearly directly with the percentage of the stroke at which the cutoff takes place—see Fig. 1. The comparative steam consumption curve shown on the chart is based on the arbitrary choice of steam consumption with cutoff occurring at 10 per cent of stroke as unity. At 20 per cent cutoff, then, the comparative consumption is about 2, and so forth. The "Mean Effective Pressure" readings of Chart I divided by the corresponding "Comparative Steam Consumption" readings then measures what may be termed the "Comparative Economy in Steam Consumption," the values of which arbitrarily chosen properly are tabulated as Table II. This table as well as Table I applies only to conditions where there is neither back pressure nor partial vacuum—that is, where the exhaust pressure is exactly the same as the atmospheric and a pressure gage on exhaust would register zero.

Each pound of back pressure decreasing the mean effective pressure by a pound, it would also decrease the "Comparative Economy in Steam Consumption" by a certain percentage, depending upon both the initial steam pressure and the point of cutoff. Any vacuum created by a condenser would have just the opposite effect, the mean effective pressure would be increased by a fixed amount for each inch registered by the mercury gage and the "Comparative Economy in Steam Consumption" bettered by a percentage depending upon initial pressure and point of cutoff—that is, upon the mean effective pressure. The amount of loss or gain in power output from such causes, though readily calculated, can be much more conveniently ascertained from a chart. Expressed in percentages of the mean effective pressure that would exist were there neither back pressure nor suction, the loss in indicated power output per pound back pressure and the gain per inch vacuum reading of the mercury gage is shown in Fig. 2.

TABLE II. COMPARATIVE ECONOMY IN STEAM CONSUMPTION

Cutoffs Per cent stroke	Steam Pressure—Lb. per sq. in.—Gage 80	100	125	150	175	200
10	16.50	23.20	31.50	40.00	48.50	56.30
15	18.10	23.40	30.45	37.65	45.00	52.00
20	17.35	22.50	29.15	35.60	42.25	48.50
25	16.75	21.40	27.50	33.40	39.40	45.40
30	15.97	20.35	25.90	31.40	37.00	42.60
35	15.20	19.30	24.60	29.55	34.75	39.80
40	14.98	18.25	23.10	27.90	32.60	37.40
45	13.75	17.33	21.83	26.40	30.80	35.15
50	13.10	16.48	20.70	25.00	29.30	33.50

This illustration of the losses and gains emphasizes facts that appear to be frequently overlooked: First, that back pressure is much more harmful when the cutoff takes place early in the stroke and when the initial pressure is low; second, that the gain from condensing operation is much more marked when the steam admission port is closed early in the stroke and is also more marked when the initial steam pressure is low. The later the cutoff, the less does the loss due to back pressure become and the less are the benefits to be derived from the use of a condenser.

If the engine previously referred to was of the non-condensing type, the loss due to each pound of back pressure, when operating on 125 lb. steam, would be 1.78 per cent of the amount of power that would be developed were there no back pressure, see Fig. 2. The effect of reducing back pressure by a pound, assuming a heating value of 12,500 B.t.u. per pound of fuel, would be the saving of a ton of coal every 5 or 6 days, if the boiler efficiency were as high as 80 per cent—an economy about 8 times as great as that which would be derived by increasing the steam admission pressure to 150 lb. per sq. in. Should the engine be run condensing, an increase of 1 in. in vacuum maintained would net a saving of about 0.87 of one per cent of the output with zero back pressure, see Fig. 2. This, by

readjusting the point of cutoff, would result in the saving of about a ton of coal every 2 weeks or so for each inch of betterment in degree of vacuum carried, the boiler efficiency being again taken as 80 per cent, the heating value of the coal at 12,500 B.t.u. and the same output and hours of service requirements.

Should conditions be such, at the time of remodeling such a plant, that operation be changed from noncondensing against a back pressure of 4 lb. per sq. in. to condensing with a 28-in. vacuum, a betterment in fuel consumption per i.hp. of 31.5 per cent would result. The engine developing 150 hp. when run noncondensing would develop an indicated power output of nearly 200 hp. when operated with a condenser, on the same fuel consumption, steam pressure and quality of steam.

The foregoing clearly indicates what may be termed some of the rudimentary economics of steam engine operation and points out the most obvious improvements to be striven for in any power house. The hypothetical case that has been considered is so similar to conditions frequently encountered in practice that a tabulation of the possible economies to be realized for such an engine operating on steam at 125 lb. gage pressure may prove of value for reference. Such a record is presented

TABLE III. POSSIBLE ECONOMIES IN OPERATION OF A 150-HP. ENGINE

Normal Conditions: 125 lb. steam (gage); cutoff at 19 per cent stroke; boiler efficiency, 80 per cent. Fuel, 12,500 B.t.u. per lb.

Normal Operation: 10-hr. day, 6 days a week.

Alteration	Change in cutoff	Economy resulting in consumption of fuel
Increasing Steam pressure to 150 lb.	15 per cent stroke	1 ton each 6 or 7 weeks
Decrease of 1 lb. back pressure	Slightly earlier	1 ton each 5 or 6 days
Increase of 1 in. vacuum	Slightly earlier	1 ton each 2 or 2½ weeks

as Table III, which well emphasizes the importance of overcoming all possible back pressure in a noncondensing installation and of improving the degree of vacuum when operating engines with a condenser. A simple remodeling of the exhaust line in a noncondensing plant and a removal of any devices that may have a tendency to produce a back pressure frequently brings about a decided increase in efficiency and saving of fuel. Improvement in condenser efficiency is not so simple, but still is well worth striving for. The gain to be derived from the use of higher steam pressures is secondary, compared to that which can be obtained through betterment of exhaust conditions, and should wait until every possible effort has been made to secure the best results and conditions for the steam after it leaves the engine cylinder.

Table III also serves to indicate the seriousness of an accident that is liable to occur in any condensing plant—namely, the loss of vacuum due to the sticking of a steam trap or other cause. For instance, should a 150-hp. engine, ordinarily be operated on a 28-in. vacuum and through the failure of some piece of apparatus, this vacuum be broken and the engine subjected to a back pressure of 5 lb. per sq. in., not only would the engine be in danger of disastrous overloading, but, in order to maintain its output, about a quarter of a ton more coal per hour would have to be burned, subjecting the boiler to heavy strains and greatly increasing the difficulty of maintaining the boiler pressure. A sudden load of about 85 per cent of the normal capacity of the engine would be thrown on the equipment, a peak that might come at a time when the plant was struggling under all it could carry.

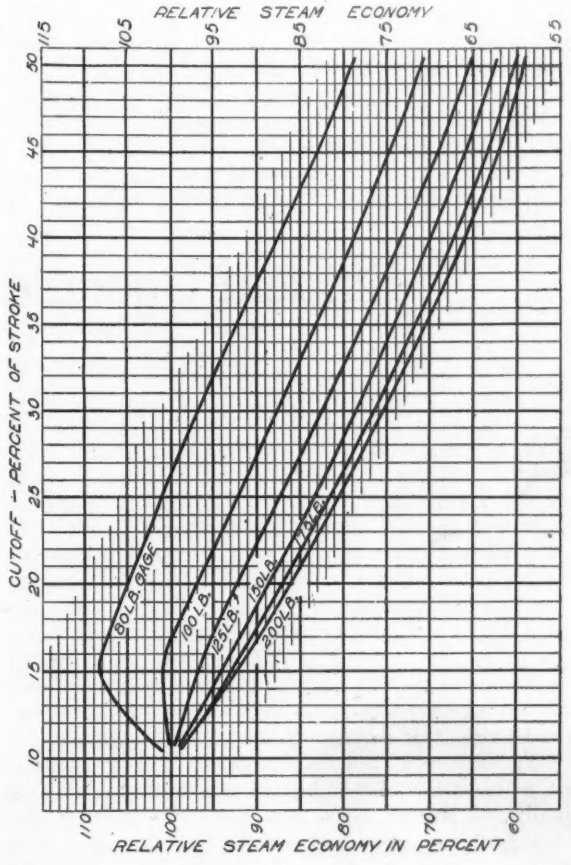


FIG. 3. RELATIVE ECONOMY IN STEAM CONSUMPTION AT VARIOUS CUTOFFS, BACK PRESSURE 0 LB. GAGE

Every improvement in steam consumption permits an earlier cutoff and, as a rule, the earlier the cutoff the greater the economy in the use of steam. This would apparently indicate that to secure the maximum of economy, the greater the piston area, the more the steam would be husbanded, as an earlier cutoff would be possible with a larger piston area. Ordinarily this is so, within reasonable limits, but not always. Table II gives what was termed the "Comparative Economy in Steam Consumption" at various points of cutoff and common boiler pressures. If, then, the comparative steam consumption with cutoff at 10 per cent of stroke be taken as 100 per cent, the relative steam economy in per cent at other cutoffs is readily calculated. Such results are plotted in the curves of Fig. 3 and show some interesting facts that are not usually recognized.

When steam of comparatively high initial pressure is employed, the earlier the cutoff the greater the economy; but when low-pressure steam is used there is a point, well within the practical working range of point of cutoff, at which any earlier cutoff would result in an actual loss in economy. The most economic point of cutoff for 80 lb. gage steam is at about 15.5 per cent of stroke. A cutoff as late as 26.5 per cent of stroke, when using steam of such initial pressure, is about as economical in the consumption of steam as one at 10 per cent of stroke. Cutoffs later than 26.5 per cent of stroke entail uneconomical use of steam, but so also does a cutoff before the piston has traveled 0.1 the length of the cylinder; in fact, the waste due to such extremely early cutoff would be even more serious than that which would take place when the steam is cut off from the cylinder after the piston has journeyed an appreciable distance past the 26.5 per cent point.

In the case of 100 lb. steam, the best economy is realized when the cutoff takes place between 14 and 15 per cent of stroke and the economy is no poorer with the cutoff at 17 per cent of stroke than it is with the admission of steam to the cylinder stopped when the piston has completed but 10 per cent of its travel. Practical limitations prevent the cutoff being set earlier in the stroke than 10 per cent when using steam of ordinary gage pressures, so it is only when employing steam of 100 lb. gage pressure or less that care must be taken not to have the cutoff take place too early in the stroke.

If any general rules are to be advanced as guides for securing economy in steam consumption, they may be summarized as follows: For noncondensing engines, overcome all possible back pressure, adjusting the cutoff as early as possible in the stroke, provided the initial steam pressure is at least 100 lb. per sq. in. For condensing engines, improve the condenser vacuum as much as possible. Having thus obtained the best possible exhaust conditions, and not till then, increased steam pressures with earlier cutoffs may be resorted to for improving economy.

Efficient Operation of Boiler Rooms

New Equipment and Operating Features of a Highly Efficient Central Station Boiler Room

IN a central station plant furnishing power for electric railways and commercial purposes and steam at reduced pressure for heating factories and other buildings, new steam generating equipment has been put into operation recently which is complete in every detail and the operation has been so thoroughly worked out that this plant ranks high among the efficiently operated plants of the country. The plant is tied in with the Niagara system, which sometimes throws its city load upon this plant. Peak loads are, therefore, common, most of the time coming at regular periods of the day, but occasionally, when Niagara power fails, no warning is given and the boiler room must be kept in position to meet this emergency.

One section of the boiler plant has been in operation for years and is still doing service, but is used principally as a booster, being thrown into service as needed during peak loads and during the heating season some of these old boilers are used to furnish all steam for commercial heating.

The new section of the boiler plant was put into operation about a year ago and while not as yet entirely completed, the plans provide for strictly modern equipment with all conveniences and instruments which are thought to be reliable and of value in the operation of the plant.

In the old plant are 10 B. & W. 600-hp. boilers served by Roney stokers. Standard 3-pass settings are used and the boilers work at 170 to 175 lb. steam pressure. Six of them have superheaters, of which 2 are B. & W. and 4 Foster, designed to give 100 lb. superheat. In starting the boilers, the B. & W. superheaters are flooded until the boilers are ready to cut into the system, when they are drained, but the Foster heaters are left dry all the time.

Turning to the new plant, we find here 6 Bigelow-Hornsby water-tube boilers with space still remaining for 6 more of the same size. These are each rated at 875 hp. and designed for 220 lb. pressure and 135 deg. superheat. Taylor stokers serve these boilers, each stoker having 9 retorts. A Sturtevant economizer is placed beneath the boiler and a Sturtevant fan driven by a Westinghouse turbine furnishes air at 4 in. water pressure for the furnace.

Bigelow-Hornsby boilers are made up of nests of tubes, called units; these are placed nearly vertical, slanting merely enough to allow space for the steam drum between the upper headers. Each unit consists of 21 3¼-in. tubes and the boiler is made up of 28 units, 7 wide and 4 deep. Baffling is placed between the units in such a manner as to allow uniform passage of gases over the tubes. The baffles between the front row of units extend to within 4 ft. of the upper header, in the back units they extend clear up, while the intermediate baffles are not as high as the front baffles. It was found that a higher superheat was obtained when the front baffles were lowered and they are not now as high as when originally installed.

The standard brick setting is employed with firebrick lining in the furnace; baffles and bridge wall are also of firebrick. Over the top of the setting are iron plates, on rods, over which is a covering of asbestos to cut down radiation. Clean-out doors are provided on all sides, giving access to the tubes, also there are 4 holes in the setting to give access to the superheater.

As ordinarily operated, these boilers develop 150 per cent of their rating and during off peak loads the firemen are instructed to cut in a boiler when the load gets to 175 per cent of the combined rating of the boilers in service. On peak loads it is customary to run them as high as 200 or 225 per cent of their rating, which is based on 10 sq. ft. of heating surface per horsepower.

The grate surface of Taylor stokers is rated in retorts, in this case there are 9 to each boiler or 972 sq. ft. heating surface to one retort.

The bridge wall is in front of the lower front header and extends 2½ ft. above the floor of the furnace. This dimension makes the shortest distance from the grate to heating surface 6 ft., while the average is about 12 ft. With this type of furnace, it will be noted that the gases from the coal just fed have the farthest distance to travel to the heating surface.

On each boiler are 2 water columns, a Williams and an Anderson, both having Lonergan trimmings, and provided with high and low water alarms. They are placed on the exposed end of the steam drum. Copes feed water regulators will be placed on all boilers to maintain the water level.

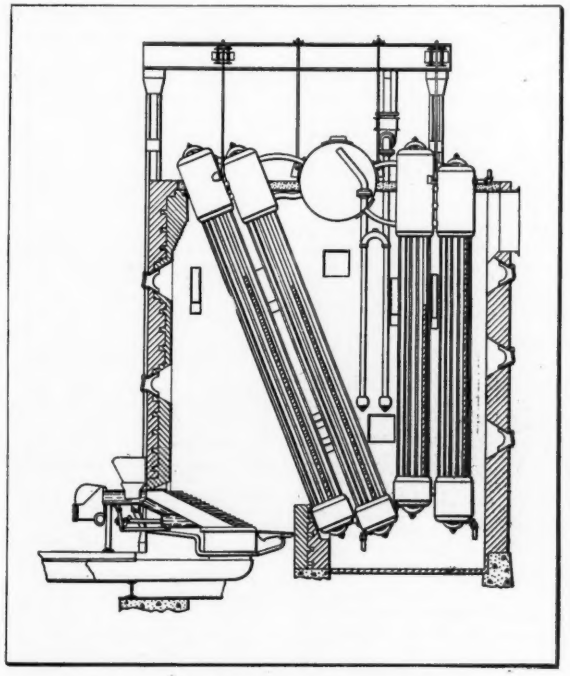


FIG. 1. CROSS SECTION OF BOILER SETTING

Each fireman as he comes on his shift is required to blow down the water columns and try his safety valves before his predecessor leaves. For convenience, chains run down to a short distance from the floor by means of which the safety valves are tested.

A 1-in. fusible plug is placed on the fire side of the front top header; this location requires the shutting down of the boiler to replace the plug.

The feed line enters the top of the back header, then turns down with an ell and nipple, extending to 18 in. below water line.

There is a bottom blowoff pipe for each back unit, 7 in all, the front bottom header is drained by similar connections. These blowoffs are opened once in 24 hr., no 2 boilers at the same time but during the periods when the boiler is not steaming. The front blowoff is used to change the water, keeping it from becoming too concentrated with impurities. This is also the purpose of a 1¼-in. drain pipe on the steam drum, which is opened every half hour for 15 sec. The bottom blowoff lines are of 2-in. pipe, in each of which is placed an angle Cadman valve, the 7 pipes lead to one 2½-in. header in which is located an Everlasting blowoff valve. The front drain is of 1¼-in. pipe with an ordinary globe valve. These valves are merely opened and closed giving time for the water to run out of the pipes.

On the top of each steam drum are 4 4-in. Ashton pop safety valves set to pop at 200 lb. and tested at the beginning of each shift.

The manholes are standard for the Bigelow-Hornsby boilers, being located one at top and bottom of each unit, and one on the steam drum. There are no steam baffles, dry pipes or dome, the steam going direct to the superheater and then to the header.

A Foster superheater is located below the steam drum, between the second and third headers, designed to give 135 deg. of superheat. As stated previously, the

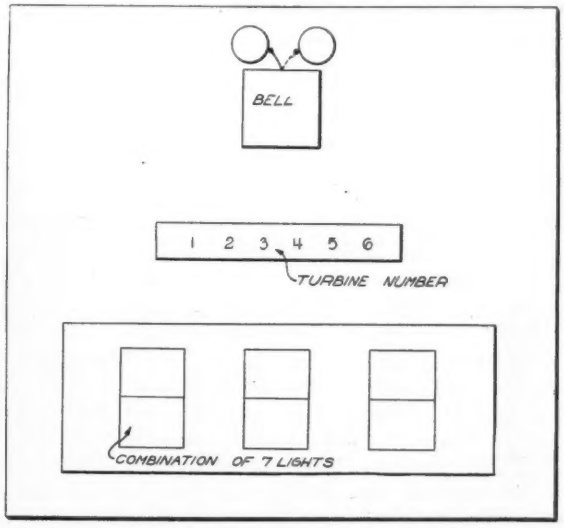


FIG. 2. SIGNAL ARRANGEMENT IN BOILER ROOM

amount of superheat is governed somewhat by the height of the baffles between the first and second row of units.

Taylor stokers are used under those boilers, each having 9 retorts. The coal burned is Pennsylvania slack with a heat value of about 13,500 B.t.u. per pound. The depth of fuel bed over the tuyeres is in the neighborhood of 2 ft., but varies considerably with the load being carried.

A forced draft of 4 in. is the maximum carried under the furnace, which is reduced to 2 or 2½ at a load of 150 per cent rating. The draft over the fire is ordinarily 0.2 in., increasing to 0.6 or 0.8 in. back of the damper.

As the coal is fed to the boilers it is weighed by Richardson automatic scales; water is measured as it comes from the heater by a Lea V-notch meter, giving the total amount fed to all boilers, and steam is measured by G. E. steam flow meters, with which each boiler is provided; these indicate and record the steam delivered.

In the power plant reports the following temperatures are recorded:—Outside atmosphere, feed water from the heater which varies from 100 to 150 deg., temper-

ature of flue gases leaving the boilers is taken occasionally and varies from 600 to 650 deg., while at the outlet of the economizer it is 300 to 350 deg., feed water entering the boiler from the economizer is taken regularly and varies from 220 to 270 deg. No means have been provided for taking furnace temperatures.

Analyses of the flue gases are made occasionally with an Orsat apparatus. Although an automatic CO_2 recorder was provided, it gave so much trouble to keep it in order and accurate that its use has been discontinued. The percentage of CO_2 varies from 8 to 15, the heavier load giving the higher percentage CO_2.

heads are removed and all sludge taken out, the boiler is given a thorough inspection inside and out, also the furnace and settings, and wherever even the slightest defects are noted, the parts are replaced or permanently repaired. After 9 months of operation no injurious scale has been found in any of these boilers since treated water has been used, nor is it expected to be necessary to run the turbine cleaner through the tubes at any time except as a precaution to see that a tube has not become stopped up. Before putting the boiler in service again, it is tested up to allowable working pressure with water to insure against leaks.

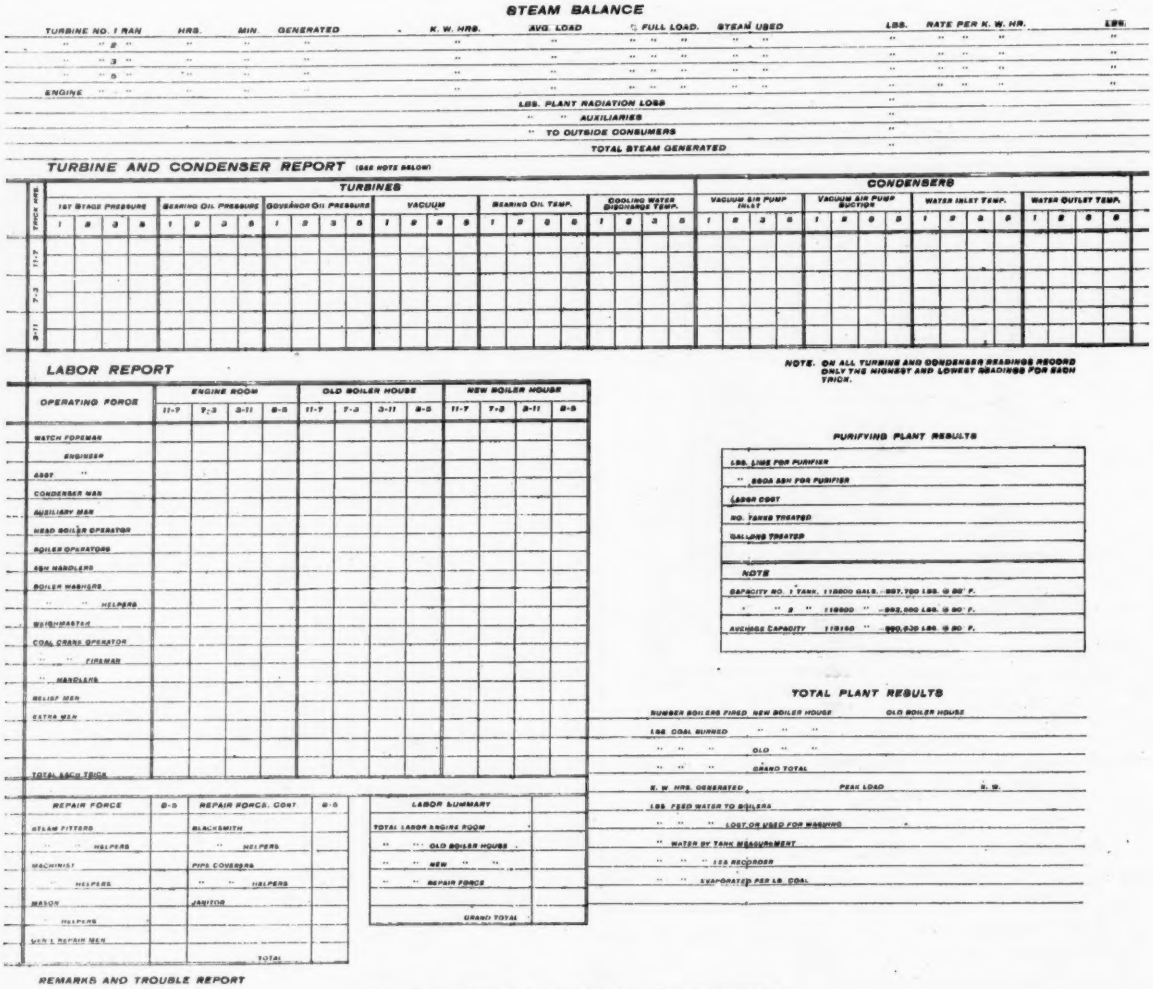


FIG. 3. PART OF FORM FOR DAILY REPORT

While this company does a great deal of industrial heating, the condensate is not returned to the plant, feed water is taken from the river and treated by the We-Fu-Go system of water softening before being fed to the boilers. A chemical test of each tank of treated water is made as a guide for treating the next tank.

The rules of the plant are to run a boiler 30 days, then take it out of service and wash it as soon as temperature will permit. The principal difficulty met here is to get the fire out of the furnace on account of the immense size. While the boiler is down, the manhole

Soot is blown off the tubes once a week by inserting an air pipe with a perforated nozzle through the clean-out holes in the settings. This is done when the boiler is off the line, being held in reserve for a peak load.

The coal and ash handling system was designed by the C. W. Hunt Co. and consists of industrial cars run on narrow gage tracks and an elevator system for the cars. Coal comes to the plant on the bank of the river, which is nearly on a level with the tops of the boilers. From here it is either dumped into storage on the side of the river bank or loaded into industrial cars by means

of a clam shell shovel and taken to bunkers over the boilers. Two chutes lead to each scale, the discharge of which divides into 2 branches which deliver the coal to the hopper of the stoker.

Ashes from the stokers are carried by means of hoppers and a chute 40 ft. long to industrial cars in the basement, then elevated to an ash storage over the railway tracks. Back of the bridge wall in the setting is what is known as a soot pit; this is cleaned out by removing a few bricks from the bridge wall, arranged for that purpose, and washing the accumulation out with a stream of water, the refuse running to the river.

With forced draft, leaks in the setting do not affect the economy greatly. At times when the fires are being forced, there is a pressure within the setting slightly above the atmosphere, and any leakage will be shown by smoke coming out of the setting. To stop up holes in the settings, fire clay or brick mortar is used, around the stoker air box asbestos mortar is used.

To prevent clinkers from sticking to the side of the furnace, a small air space is left between the stoker and the wall. This allows cool air to enter and lower the temperature of the clinker below the fusing point and prevent it from running from the walls to the furnace tuyeres.

According to records kept, the average amount of water evaporated per pound of coal as fired is 9½ lb.

The boiler room force operates in 3 shifts, on 2 shifts there are 4 operators and on 1 shift 3 operators; besides these there are 3 washers and a helper, 2 repair men, 1 mason and his helper.

A load indicator in the boiler room is operated from the switchboard in the engine room. When a change is going to be made in the operation of the generators, the switchboard attendant signals what it will be by means of the bell. The units which are running are indicated by lighting up the proper figures in the center of the indicator and the average load being carried is indicated in thousands of kilowatts by the lower signal, which consists of 3 7-light combinations.

COMPLETED PLANS for Electrical Prosperity Week have been approved by the Society for Electrical Development, and the proposed plans will be furnished complete, in a 20-page booklet, to anyone interested in the work.

Prosperity is to be the main theme of the campaign, the effort of bankers, businessmen and citizens being to rout the bogy of hard times and convince people that the prosperity of this country is real and lasting.

While all the details have not been announced, the campaign generally has been planned. Some 10,000 bill boards will carry the messages of cheer; electrical vehicle parades will be held in the large cities; the Lincoln Highway will be a blazed trail from the Atlantic to the Pacific, and White Ways will hold forth brightly in the greater cities. All electric supply houses and supply departments of electric companies will be open, and every effort made to arouse a country-wide enthusiasm. This week, which is the closing week of the Panama-Pacific Exposition, will be specially celebrated at San Francisco, closing this great enterprise in a veritable "blaze of glory."

Inspection of Low-Pressure Boiler Operation

BY N. DEVERING

THE question is sometimes asked, Should boilers used for heating purposes only, be inspected?

They certainly should be, and quite frequently; for a large percentage of the heating boilers throughout the country are in charge of persons knowing very little about them, and less about the possible dangers connected with their operation.

Following are a few examples of what some of the inspectors find when inspecting heating boilers:

In a public school building in which there were several hundred children, the janitor was informed that hot water was running from the cold water bib at one of the wash stands. He investigated and found the report true and was some time in discovering that the water had been shut off on the street, to permit of some repairs on the supply line. The janitor's assistant had opened the feed valve to allow water to enter the boiler, and as there was no check valve in the feed line near the boiler, water, instead of entering the boiler, began to leave it as soon as there was an opening made along the line. The pressure in the boiler was greater than that on the supply line and when water was drawn from the system, it began to leave the boiler.

There are many heating boilers being operated without check valves in the feed or return lines, and their absence has ofttimes been the forerunner for a bunch of trouble.

In an institution in which 50 persons were dwelling, was a hot water heating system; with the usual expansion tank at the top of the system. This system of heating is considered very safe, as there is only the weight of the water reckoned as the highest obtainable pressure thereon. When the inspector visited this building, he was advised by the woman in charge, that the register (altitude gage) was out of order. The pointer was loose on the pin and the gage did not register. Being asked how she knew whether there was water in the boiler, she replied that—she put a little in now and then, to be sure.

The expansion tank was found empty and the water very low in the system. Had the water been run in until the expansion tank overflowed, they might have played safe without the altitude gage in service. The expansion tank was located near a window on one of the upper floors, and in the autumn when the weather suddenly gets cold during a night, the pipes under the expansion tank could freeze up. The next morning a hurried fire under the boiler would tend to expand the water and with the pipes frozen at the top of the system and no relief valve on the boiler, the weakest part of that system would soon proclaim itself. The gage was repaired and a safety valve attached to the top of the boiler, set to relieve at a pressure slightly in excess of the weight of the water in the system.

Low-pressure heating boilers are usually looked after by everybody (and nobody in particular), therefore they should receive frequent and careful inspection.

Electrical Machinery and Appliances

For Generating, Transmitting and Using Current

Hamilton Electric Incline Railway

PLATFORM CARS RUN ON 800-FT. TRACK WITH 40 PER CENT GRADE; STORAGE BATTERY SUPPLEMENTS MOTOR GENERATOR PLANT

COMPLETE electric hoist equipment has been recently installed by the Hamilton Mountain Park Co., Ltd., Hamilton, Ont., Canada, to operate its incline railway for transporting passengers, freight automobiles, trolley cars, teams, etc., up the "Mountain," as it is called. The railway was formerly operated by a steam hoist equipment, but this had become inadequate to handle safely and quickly the rapidly increasing traffic. The incline gives ready access to a large tract of land the company has acquired at the top of the mountain and to the fertile country beyond. The "mountain" is really the Niagara escarpment, the high bluffs behind Hamilton being a prolongation of the heights at Queenstown, over which the Niagara river originally flowed before cutting back the gorge to the present falls. The difference in elevation between the general level of the city and the plateau of the bluffs is 325 ft.; and as the roads leading up bluffs are necessarily steep, the incline railway handles a very extensive miscellaneous traffic. All the electric hoist equipment was furnished by the Canadian General Electric Co., Ltd., and involves many novel features and numerous automatic safety devices.

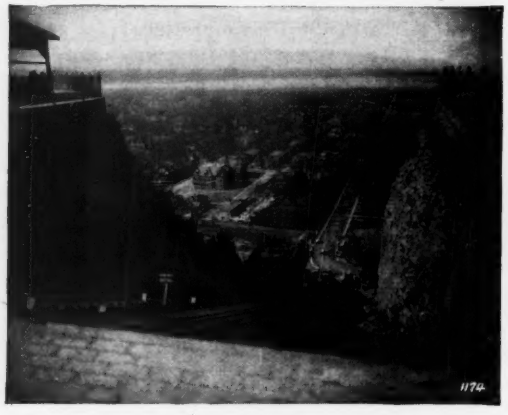


FIG. 1. HAMILTON MOUNTAIN PARK ELECTRIC HOIST SHOWING INCLINE FROM THE TOP

A special double fixed-drum, double-geared electric incline hoist, built by the Lidgerwood Mfg. Co., New York, operates 2 large platform cars in balance on an incline 800 ft. long with a grade of 40.27 per cent. Each car weighs 30,000 lb. and will carry an average load of about 20,000 lb.

ELECTRICAL EQUIPMENT

POWER for the operation of this equipment is supplied in the form of 3-phase, 25-cycle alternating current; and for changing this into direct current, a motor-generator set of sufficient capacity has been installed to supply the average demand of the hoist, plus some surplus for charging the battery described below. The direct-current end of this machine is rated at 165 amp. continuously at 550 v., the latter being the floating voltage of the battery. The generator which is driven by a 2200-v. induction motor, is designed with a special drooping characteristic by means of a reversed series field for the purpose of throwing load fluctuations on the battery. A small percentage of the load fluctuations falling on the machine will lower its voltage to such an extent that the battery must discharge and furnish the balance of the momentary demand. The regulation is, therefore, inherent in the design of the machine, and is entirely automatic.

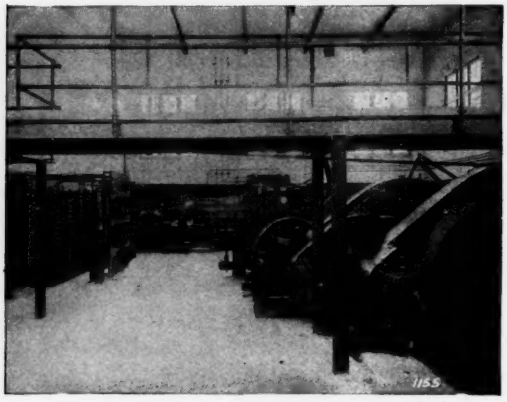


FIG. 2. GENERAL VIEW OF INTERIOR OF POWER HOUSE

STORAGE BATTERY

THE POWER PLANT has been supplemented by a storage battery built by the Electric Storage Battery Co. of Philadelphia. One of the objects of installing this was to reduce the maximum peaks due to the fluctuating load of the hoist, and thus reduce the power bills. Another object was to furnish current for operating the hoist if the alternating current supply should be interrupted.

In general, the battery consists of 262 cells of the Tudor-box type, each cell containing 11 plates, measuring approximately 11 by 10½ in., 5 of the plates being positive of the Tudor type and 6 negative, of the box type. The plates are supported in glass jars mounted on glass sand trays, the entire battery being installed on wooden racks. The capacity of this battery is 200 amp. for 1 hr. on a continuous discharge. For intermittent service extending over several hours, the ampere-hour capacity will be somewhat greater, and it is estimated that this battery will operate the hoist under the

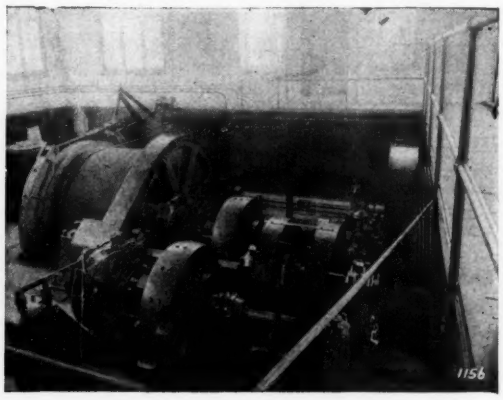


FIG. 3. HOISTING MACHINERY SHOWING MOTORS, GEARED CONNECTORS TO DRUMS, SOLENOID BRAKES, CLUTCH AND FLYBALL SPEED LIMITING DEVICE

average load conditions cited above over 1¾ hr. with the power supply entirely cut off; or if the schedule is reduced, so that the trips of the hoist are made less frequently, the hoist can probably be kept in operation for several hours.

Under normal conditions, with the motor-generator supplying the average load, the battery does not become exhausted, but receives back sufficient charge during the period of rest between trips to make up for the discharge while the hoist is in operation. The battery, therefore, while relieving the motor-generator and power line of the severe load fluctuations, is maintained at all times practically full and ready to supply the entire demand in case of interruption to the power supply.

MANY DEVICES have been adopted for fighting fires in the factory. One recently adopted is a mixture of sawdust and sodium bicarbonate, for extinguishing japan and gasoline fires. It sometimes occurs, however, that the operator in a paint department, where such combustibles as these are used, is severely burned owing to no provision being made for putting out a fire quickly should his clothes become ignited.

This has been overcome in one factory by having detachable holders on the walls in departments where inflammable materials are used. The holders are similar to those spring clasps for holding papers together. On the blankets is printed "FOR FIRE ONLY."—The Canadian Manufacturer.

The Use of Current-Limiting Reactors*

BY W. M. DANN AND H. H. RUDD

CURRENT-LIMITING reactance coils, or reactors, as they are now called in the new Standardization Rules of the American Institute of Electrical Engineers, are coils designed to limit to a predetermined value the current that can flow when a short-circuit occurs in alternating-current circuits in which they are placed.

Limiting the current value on short-circuit to a definite figure is of benefit to the generating and distributing system in 2 ways:

(a) By reducing the mechanical stresses in connected apparatus due to a reduction of the short-circuit current.

(b) By minimizing the reduction in voltage due to a short-circuit.

PROTECTION TO APPARATUS

THE CURRENT that can flow when short-circuit occurs depends upon the impedance of the circuit. The mechanical stresses that are produced at such a time in the windings of connected apparatus and in switches and cables are proportional to the square of the current. If the impedance of the circuit is low and the short-circuit current high these mechanical stresses may become tremendous, and unless everything in the circuit is substantially made and all windings securely braced, distortion and breakdown may result. By introducing reactance in the circuit the impedance is raised and the short-circuit current reduced. If by inserting reactance in the circuit the total amount of reactance is doubled, the current, when a short-circuit occurs, will be reduced to ½, and the stresses to ¼ of their previous value.

PROTECTION TO SERVICE

THE HEAVY short-circuit currents that flow in a system unprotected by reactance coils, besides creating severe mechanical shocks which may cause an interruption of the service, produce a big drop of voltage, due, not only to the flow of the current through the impedance of the circuit, but also to a demagnetizing effect which it has on the generator fields. This drop of voltage affects the whole system. Reactors may be placed in the circuits in such a way that they will not only reduce the mechanical strains due to the "short" but will also practically localize it in the feeder or section of the bus where it occurs, and its effects on other feeders or bus-sections will be minimized.

LOCATION OF REACTORS

THERE ARE 3 places in a generating and distributing system where current-limiting reactors may be used to advantage:

(a) In the generator leads.

(b) Between sections of the bus.

(c) In the outgoing feeders.

In determining where the reactors should be placed, past experiences with short-circuits will serve to show where such troubles are likely to occur in future opera-

*From a paper presented at the meeting of the Ohio Society of Mechanical, Electrical and Steam Engineers, Toledo, O.

tion; having data of this kind, a study of the layout of the system will show where the reactors should be placed.

If the generator windings show any signs of weakness and the records show that "shorts" between the generators and bus-bars are not uncommon, reactors should be placed directly in the generator leads. This is the surest method of protecting a weak generator or its circuit-breakers; it is not very effective, however, in limiting the current that can flow into a short-circuit on some feeder, and it does very little good in minimizing the drop of voltage at the bus-bars.

If a number of generators are used in parallel, a "short" in any generator or between a generator and the bus-bars will cause all of the generators to feed into the "short," and the bus-bar voltage will drop practically to zero. If such "shorts" are likely to occur, it will be desirable to sectionalize the bus, and place reactors between the sections. This will limit the current that can flow between generators, and have a marked effect on maintaining the voltage of the bus-bars when a "short" occurs.

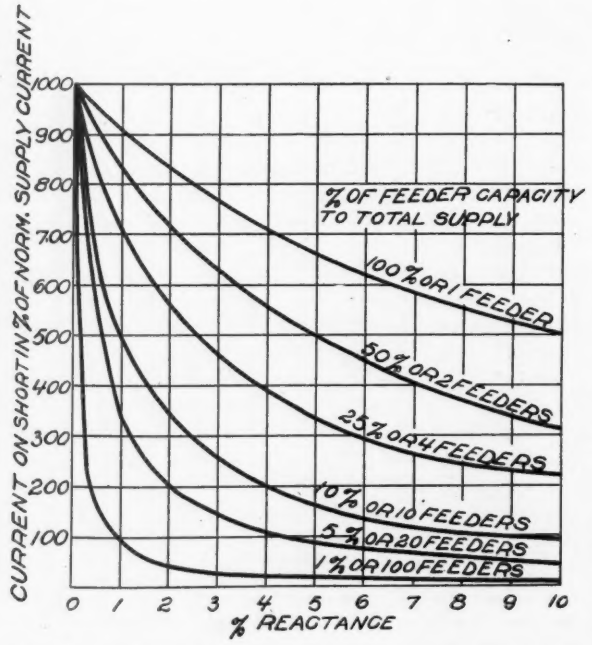


FIG. 1. EFFECT OF FEEDER REACTANCE IN LIMITING THE SHORT CIRCUIT CURRENT IN FEEDERS

If a large percentage of the "shorts" occur outside of the station on the feeders, and statistics show that this is where the majority of such troubles occur, reactors placed in the feeder circuits will be very effective in protecting the apparatus and maintaining service. The feeder reactor will practically localize the trouble in the circuit where it originates; the reduced short-circuit current in that one feeder will be of little importance in its effect on the generators and therefore on the bus-bar voltage; the feeder breakers will be protected and the circuit opened more safely.

It has been common experience in cases where the generating capacity of a station is added to from time to time, that the feeder cables and circuit-breakers begin to give trouble from the increased severity of short-circuit troubles. When reactors are inserted in the feeder circuits, additions to the generating capacity become of very much less importance in increasing the short-circuit troubles. In stations of the usual type where the feeders are relatively small in capacity compared to the total generating capacity, feeder reactors of the proper size will render the feeders practically immune from further troubles, no matter how large the generating capacity becomes.

One of the serious effects of a drop in bus-bar voltage is that all synchronous apparatus of the system will be likely to fall out of step and be shut down. Reactors placed directly in the generator leads will offer no protection against such trouble. Bus-bar reactors will be effective in confining the trouble to practically one section of the bus. Feeder reactors will be most effective as they will minimize the effects of a "short" on the bus-bar voltage.

The size and number of generators in a system where the need for current-limiting reactors is felt, the size and number of the feeders, the cost of the reactors and the space available for their installation are some of the factors to be taken into account in deciding their location. The study of a particular system might result in a combination of more than one of the locations referred to or perhaps all three.

Amount of Reactance

The right amount of reactance to use in protecting a system forms a problem which requires careful study; it is the final step in arriving at the actual specifications for the reactors.

Reactance may be compared to life insurance. The amount should be sufficient to give protection; it should not, however, be so great that it is a hardship to carry it. With no reactance, no protection is given. With an unreasonably large amount of reactance the first cost and the cost of the electrical losses in the reactors form an excessive premium to pay. It seems that the right amount to use generally lies between a minimum of 2 per cent and a maximum of 7 or 8 per cent.

In considering the amount of reactance to be placed in the leads of generators, the armature reactance of the machine and the short-circuit current it would allow, if left to itself, must be considered. A high-speed turbo-generator may have from 7.5 to 10 per cent inherent reactance at the instant of short-circuit; a slow-speed engine or waterwheel type of generator may have twice this amount. Five per cent reactance added externally to the turbo-generator with its 7.5 reactance will reduce the current at short-circuit to 60 per cent of what it would be without protection, and the mechanical stresses would be reduced to 36 per cent. The same amount of reactance added to the slow-speed generator with its 15 per cent inherent reactance will reduce the short-circuit current to 75 per cent of what it would be without external reactance, and the mechanical stresses would be reduced to 56 per cent. To get a certain amount of protection for a generator, then, the inherent characteristics of the generator play an important part in fixing the right amount of external reactance.

The problem of how much reactance should be placed between sections of a bus-bar is more complicated; it can be solved only by a careful study of the layout of the system. In general, a compromise must be arrived at between a large amount of reactance, which would have the maximum effect in protecting the system and maintaining bus-bar voltage, and a small amount of reactance, which would allow more nearly the equal loading of generators in parallel under normal conditions.

The amount of reactance to be placed in feeders will depend upon the size of the feeder, the relation its capacity bears to the generator capacity, and the breaking capacity of the circuit-breakers.

Consider a station having a generating capacity of 10,000 kv.a., the generators having an inherent reactance of 10 per cent. If the output is distributed over 10 1000-kv.a. feeders unprotected by reactances, a "short" on any feeder will draw 100,000 kv.a. from the generators; this is 100 times the normal capacity of the feeders. The reactance of the generators is therefore equivalent to 1 per cent reactance in the feeders. If 3 per cent extra reactance is placed in each feeder, the conditions will be equivalent to a total of 4 per cent; the short-circuit current will then be limited to 25 times the normal current of the feeder, or 25,000 kv.a. on the generators, and the mechanical stresses in the system will be reduced to only 6.25 per cent of their value without the 3 per cent reactances.

If the 10,000-kv.a. generator capacity is distributed in 2 5000-kv.a. feeders unprotected by reactors, the short-circuit output of 100,000 kv.a. represents 20 times the normal capacity of the feeder, and the generator reactance is equivalent to 5 per cent protecting reactance in the feeder. This current is less in proportion to the normal current than in the case of the 1000-kv.a. feeders with their 3 per cent reactances. As far as protection to the feeder itself is concerned very little extra reactance, if any, is required; to limit the generator current to the same figure as in the previous case, and thereby keep the bus-bar voltage up to the same degree, would require an extra feeder reactance of 15 per cent. To get the equivalent protection for the bus-bar voltage, the percentage for each feeder may therefore be reduced as the number of feeders is increased.

Effect on Regulation

One thing to be considered in installing current-limiting reactors is that increasing the reactance in the system results in a slightly lower power factor and slightly poorer regulation. The effect on the regulation is more marked if the operating power factor is much below unity. However, the amount by which the voltage of the system is lowered is not seriously large; it can be compensated for by increasing the voltage of the generators. Figure 2 shows the amount by which the voltage of the system is lowered by the addition of reactance, for several different power factor conditions. For example, if 5 per cent reactances are added in all of the feeders of a station and the operating power factor is 80 per cent, the generators should be excited to give 3 per cent more voltage, to maintain the bus-bar voltage present without the reactors.

Additional Advantages of Reactance Coils

A system consisting of 2 or more generating stations in parallel will be more stable if reactance coils are used. The stability of the system depends upon the synchronizing power tending to hold the generators in step. A sudden load or disturbance near one station may cause its generators to drop in speed. This will cause a shifting in the phase of their voltage. The difference in this voltage and the voltage of the other generators will be a relatively small voltage almost 90 deg. out of phase with the generator voltages. This voltage will circulate a local current between the generators; if the circuit has plenty of reactance, the phase of this local

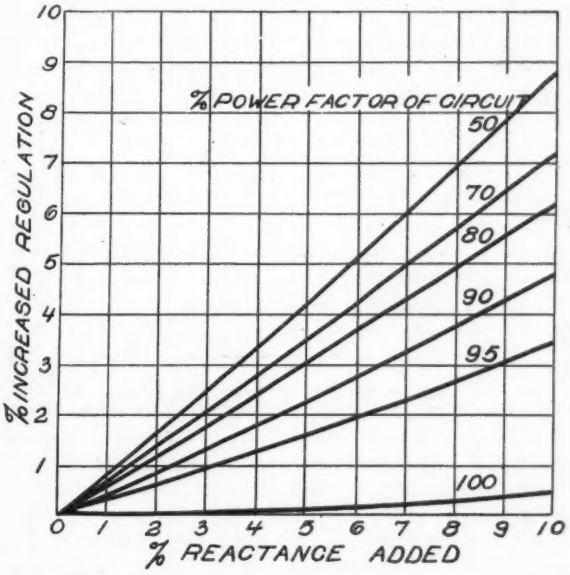


FIG. 2. INCREASE IN REGULATION FOR CIRCUITS OF VARIOUS POWER FACTORS WHEN REACTANCE IS ADDED

current is displaced almost 90 deg. from the relatively small voltage which causes it, or, in other words, almost in phase with the generator voltage, thereby giving the maximum synchronizing power.

Rating of Reactors

The characteristics of a current limiting reactor are definitely fixed by a statement of:

(a) The reactance expressed as a percentage of the normal voltage of the circuit.

(b) The characteristics of the circuit in which it is to be placed.

1—Normal kv.a.

2—Normal voltage between wires.

3—Phase of the circuit.

4—Frequency.

(c) The temperature at which it operates under normal conditions.

The normal current for the coil will be the normal value of the current of the circuit in which it is placed. For a single or 2-phase circuit this current will equal the normal kv.a. per phase divided by the normal line voltage; for a 3-phase circuit it will equal the total normal 3-phase kv.a. divided by 1.73 times the voltage between wires.

The normal voltage drop across the coil will be developed when normal current at normal frequency is flowing through the coil. This voltage drop will be the given percentage of the normal voltage between wires in a single-phase or 2-phase circuit; or the given percentage of the voltage from line to neutral (= voltage between wires ÷ 1.73) in a 3-phase circuit.

Current-limiting reactors must of necessity carry the maximum overload currents which the circuit is called upon to carry, and with a reasonable ultimate temperature. Reactors of this kind, however, can safely operate at a higher temperature than would be safe for generators and transformers, due to the open and well-ventilated construction which is possible, and for the reason that materials which will not be injured by such temperatures can be used. Since a higher operating temperature is reasonable and is an important factor in reducing the size and cost of such coils, a temperature rise of 75 deg. C. under normal conditions represents common practice.

Five per cent reactances for a 3000-kv.a., 11,000-volt, 3-phase, 60-cycle feeder would be designed to carry 157 amp., and to have a voltage drop of 318 volts at 60 cycles when that current is flowing. The normal rating of each of the 3 reactors would be 50 kv.a. (318 × 157 or 5 per cent of 1000 kv.a.) at 157 amp., 318 volts, 60 cycles.

Submarine Photography

IN these days of daring exploits of arms, when the engines of destruction that operate under water are the cause of so much comment, it is particularly pleasing to turn to an equally remarkable but far more humane development of science. One that seems destined to play an important part in naval affairs, is that of submarine photography, or the taking under water of pictures, both stationary and moving.

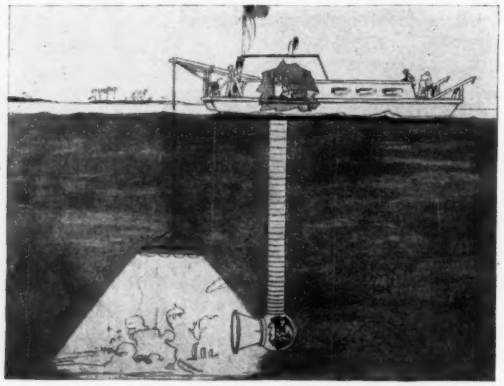


FIG. 1. SUBMARINE PHOTOGRAPHIC APPARATUS IN ACTUAL OPERATION

This work is made possible by an invention of Charles Williamson and his 2 sons, of Norfolk, Va., which consists of a collapsible accordion-like submarine tube of waterproof canvas and rubber, 3 ft. in diameter, braced at regular intervals by iron rings. This construction permits the passage of a person down the tube, and its flexibility permits it to be dragged along by a vessel. The top of the tube remains open at the deck, and the lower end extends down into the water and expands into a chamber about 5 ft. in diameter, one side of which is provided with an observation glass window through which the pictures are taken. The space in the chamber is sufficient to permit 2 men, one to operate the camera, and one to control the movement of the tube, which is effected by chains operated from the deck of the boat. Fresh air is provided by a simple device, enabling the operators to work in comfort.

In order to accomplish submarine photography, however, it was necessary to secure some efficient means of artificial illumination which could be easily handled, would furnish the desired light, and not be prohibitive in cost. After trying other types with varying success, the Cooper Hewitt quartz lamp, as illustrated in Fig. 2, was adopted. A battery of 9 of these lamps, each having 2400 c.p., was installed. This lamp consists of a short tube of pure fused quartz or silica containing vapor of mercury, which is made luminous by the passage through it of an electric current.

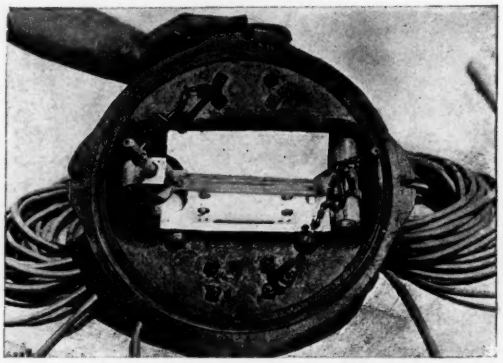


FIG. 2. COOPER HEWITT LAMP USED IN SUBMARINE PHOTOGRAPHIC WORK

The essential parts of the lamp are the quartz burner and the auxiliary. The former is the light giving tube, its support and enameled reflector, while the latter consists of the necessary tilting mechanism and coils for starting and maintaining the mercury arc.

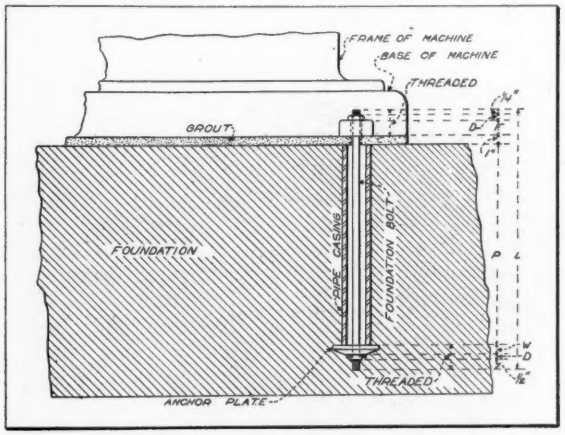
In ordinary commercial use, the burner is suspended from the lower part of the auxiliary and enclosed in a glass globe; but for submarine work, the auxiliary is kept on board the boat, and the burner with its reflector holder is mounted in a casing that is placed in a frame and lowered into the water. The construction of the lamp and its method of installation are shown in Figs. 1 and 2.

WHEN A NUT becomes fast and the bolt turns, heat the nut with a blow torch if possible. If this will not serve, cut through the nut close to the bolt on 1 or 2 sides with a hacksaw; or back the nut with a heavy sledge or other piece of metal and split the nut with a sharp cold chisel. Nuts are cheap and should always be sacrificed rather than to take a chance of ruining the bolt.

Foundation Anchor Bolts--II

DETERMINING PROPER BOLT LENGTH. BY TERRELL CROFT

DETERMINATION of the proper length for an anchor bolt usually depends upon one factor. The bolt should extend down far enough into the foundation so that it will break before it will pull out of the foundation. Where a bolt is cast solid in a foundation, obviously there must be sufficient masonry above the head of the bolt. If the masonry does not set up compactly around the shaft of the bolt, any tension imposed on the upper threaded end will be transferred to the bolt head and to the anchor plate, which will exert a shearing action on the masonry. Enough masonry must, therefore, exist between the top of the foundation and the imbedded head of the bolt so that neither the bolt head nor anchor plate can shear out the masonry alone and pull out in case the bolt is stressed excessively. If the masonry sets up to the shaft of the



DIMENSIONS DETERMINING THE LENGTH OF A FOUNDATION BOLT

bolt there will be some adhesive action between it and the bolt, which provides resistance to withdrawal.

The usual practical rule in determining the lengths of anchor bolts is to make them long enough to extend almost to the bottom of the foundation, so that there will be every assurance that the mass of masonry above the heads of the bolts will be ample to prevent their withdrawal. One "practical" rule for the average masonry foundation is that an anchor bolt should extend at least 40 diameters down into the foundation.

Another reason why the bolts are usually carried almost to the bottom of the foundation is that where this procedure is followed, the tendency to crack off an upper strata of a green or weak foundation, which might occur if short bolts were used, is eliminated.

When an anchor bolt is cast solid into a concrete foundation, the adhesion of the concrete to the bolt will equal the tensile strength of the bolt if the bolt is set in concrete a distance equal to 25 times its diameter. But, to provide a margin of safety such bolts should be set at least 30 diameters.

Anchor bolts in casings should be long enough to permit of deflection. Where a bolt is installed in a casing, the length of the bolt should be sufficient so that its top can be deflected a trifle in any direction. One function of the casing is to admit of a slight shifting of the top of the bolt, so that the bolt can be inserted into its hole in the machine bedplate even if the bolt or the bedplate hole has been mislocated a trifle. Unless the bolt is long enough so that it can be sprung or deflected a function of the casing will be defeated.

To determine the overall length of an anchor bolt for a given installation, see illustration, several increments must be added to the nominal buried length P. At the top end, the increments are: (1) A clearance of at least ¼ in. above the nut, (2) The thickness of one nut D, or of 2 nuts, if locknuts are used, (3) The thickness F of the machine bedplate or foot through which the bolt passes, and (4) At least 1 in. for grout.

At the bottom of the bolt, the following must be provided for: (1) The thickness of the anchor plate W, (2) D, the thickness of the nut, and (3) a ½-in. extended end.

PROVISION FOR REMOVAL

ALL ANCHOR bolts may be divided into 2 general classes, removable and nonremovable bolts, in accordance with the method used for their installation. Nonremovable bolts, such as those shown at A, B, C, D, F and G of Fig. 1, page 733 Aug. 1 issue. cannot be taken from the foundation after they are installed. Removable bolts, like those at E can be removed from their foundations at any time, and are desirable particularly in large installations, for 2 reasons; the first that where the bolts are removable, if one cracks or breaks, (an infrequent, but occasional, occurrence), a new bolt can be readily inserted; the second that a machine can be installed much more rapidly and at less expense where the bolts are removable. If the bolts are nonremovable, it is necessary in skidding the machine bedplate into its position to jack it up above the threaded bolt ends extending from the foundation, and then, the bedplate being in its correct lateral position, it is dropped down over the bolts. The extending bolt ends always make much extra work by interfering with the skids, and furthermore they are frequently bent or their threads battered while the machine bedplate is being installed. Where the bolts are removable, the bedplate is shifted to its correct position on the foundation and after it is in place the bolts are dropped through the holes in the bed plate through their casings and into the nut supported in the anchor plate below.

Nonremovable anchor bolts are usually restricted to small and unimportant foundations, as it is impossible to remove these bolts without cutting away considerable of the foundation. They have, however, the advantage of low cost and ease of installation. With small machines it is usually possible to use bolts which have great factors of safety, without materially increasing the cost of the foundation. Where the bolts are thus proportioned so that there is practically no likelihood of their ever breaking, the application of "built in" bolts is justified in the case of a small machine. It should always be remembered, however, that where the bolts are built in solid it is necessary to jack the machine up over their ends which extend from the top of the foundation when the machine bedplate is being set. Whether or not this will constitute a serious disadvantage is a thing to be determined in each particular case.

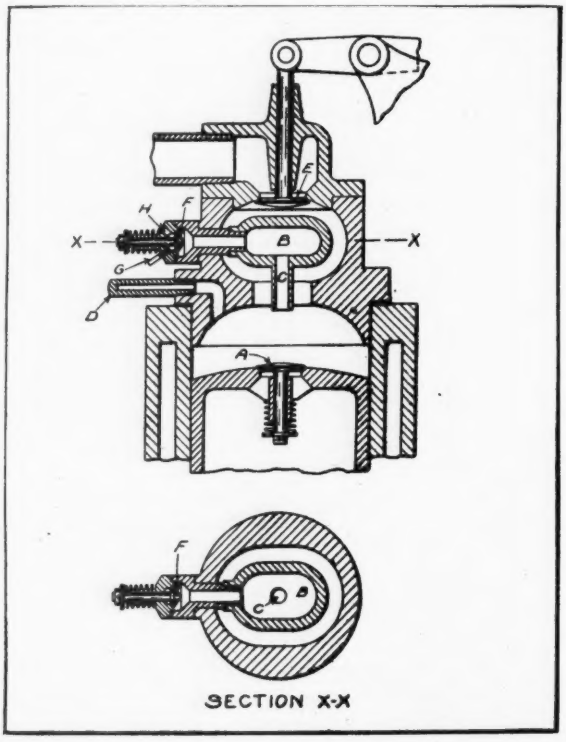
GAS POWER APPARATUS

Producers, Engines and Industrial Applications

Development of the Crude Oil Engine

By Samuel M. Howell

INDUSTRIAL operations of this age require the universal application of mechanical energy, and while all the available prime movers are now in commission, one of the insistent demands of modern life is for a cheaper and more convenient power. This has placed the steam engine, the electric motor, and the gas engine in competition to some extent, and has led to a high degree of development in all methods of motive power. The relative suitability of either system in any given



SECTIONAL VIEWS OF SPECIAL FEATURES OF TORBENSEN OIL ENGINE

case is dependent upon a number of factors, but is determined largely by the comparative cost of operation and maintenance. For a majority of the minor uses, some form of the internal combustion engine has long been regarded as the best choice, and more recently, as a later result of the greater abundance of low-priced oils and their successful application, the oil fuel motor has in some instances displaced the steam engine in large power installations, and its advantages for marine use have been successfully demonstrated. These are facts now well known, and the consensus of engineering opinion is becoming more and more favorable to the use of this means of power generation.

The general subject of the internal combustion motor has always been attractive to those who are mechanically inclined, as well as important in a commercial sense, and it is the object of this paper to present a statement of the art as related to the use of cheap fuels, from a modern point of view, and with reference to some auxiliary devices with which the use of oil fuel is closely associated. As a matter of course, all alleged improvements, whether real or imaginary, are most likely to become patented inventions, and although it is quite true that only a relatively small number of gas engine patents are capable of practical application, it is still obvious that a study of Patent Office records is the most available means by which a given art may be traced up and reviewed, and the patents herein described are those which have been mechanically successful, and may be relied upon as accurately representing the various steps by which the crude oil engine has been developed.

Kerosene and Other Oil Engines

For engines of small size, kerosene or common lamp oil is in some important respects a very suitable fuel. It is nonvolatile and comparatively safe from accidental ignition, and its heat value is somewhat higher than that of gasoline, while the price per gallon is lower; but to use it with success an efficient vaporizing device is always necessary in order to secure proper gasification, and the character of this vaporizer largely determines the performance of the engine. It is a singular fact, too, that the vapor of kerosene ignites at a lower temperature than that of gasoline, and consequently kerosene engines of the mixed compression type are often designed for a somewhat low degree of compression, to avoid preignition; 50 lb. gage was the limit formerly allowed, but this may be exceeded considerably by the use of water injection along with the fuel, and this matter will be referred to again under the heading, Injection of Water. The speed at which oil engines are usually run is not so high as that of which the gasoline engine is capable, often not exceeding 500 r.p.m. even in engines of small size, but this rises from the fact that the oil engines have been used chiefly for stationary and other work of a continuous nature, wherein an excessive speed would be undesirable, and is not at

all due to the character of the fuel. It has been determined that the rate of flame propagation in a kerosene mixture is such that the best results are obtained at a piston speed of 1000 ft. per min. This is equivalent to 1500 revolutions in an engine of 4-in. stroke, and is certainly fast enough in any case, and far beyond ordinary requirements.

The Torbensen Engine

Patent No. 653,854, July 17, 1900, V. V. Torbensen. This engine is of the self-igniting type, designed especially for the use of kerosene. The patent is representative of a class, and was followed by several other designs of a similar character by other inventors. The illustration shows a central vertical section of the special features of the patent and a sectional plan of the head, vaporizer and fuel valve. The system is 4-cycle. The main portion of the air is drawn into the crank case on the up-stroke of the piston, and is transferred to the combustion chamber through the valve A in the piston at each alternate down stroke, the engine being vertical.

During the power stroke the pressure on this valve, of course, causes it to remain inclosed; B is the vaporizer, rather heavily made of cast iron, and having a light tubular extension, C passing downward into the combustion chamber; D is the ignition tube for starting; E is the exhaust valve, and F the fuel valve. The suction stroke of the piston pulls open the air valve and also the fuel valve. The oil enters the latter at G, accompanied by a small volume of air, which is drawn in briskly at H.

The oil spray thus produced goes into the vaporizer, where it is instantly gasified, and passes downward through the tube C to mingle with a larger body of air entering the combustion chamber by way of the main air valve. The upstroke compresses the mixture thus formed and drives a small portion of it into the starting tube, where it ignites the whole charge, the tube having been previously heated, ignition being regularly effected thereafter by the heat of the vaporizer alone. And thus the engine is self-igniting, and if the parts have been rightly proportioned the ignition regularly occurs at the proper instant, whether the load be light or heavy. The reasons are these:

The governor acts by failure to open the exhaust valve, and the vaporizer is kept at a red heat by the exhaust gases which either pass through the space around it, or are imprisoned therein during the governing intervals. The temperature of the vaporizer is, therefore, practically uniform at all times, and since the speed regulation is by means of missed impulses, the quality of the mixture and the degree of compression are also uniform. The extension tube C, disposed as shown, prevents the oil gas drawn through the vaporizer from mixing with the exhaust gases with which the upper portion of the combustion space is filled. This tube, having thin walls swept by the incoming charge of oil gas, cannot become hot enough to ignite the mixture. In fact, while the body of the vaporizer is full red, this extension remains black, and the vaporizer itself cannot preignite the charge because the gas, while passing through it, is far too rich to be readily fired. Thus, the conditions being constant, the moment of ignition cannot well be otherwise.

(To be continued.)

Interesting Diesel Engine Test

Some interesting information has been obtained from the results of tests recently conducted at the works of the McIntosh & Seymour Corporation of Auburn, N. Y., on one of that company's Diesel type engines.

The engine under test was of 500 brake horsepower rating, with a cylinder diameter of 18⅞ in., and a stroke of 28.347 in., and was run at a speed of 165 r.p.m.

Approximately 3½ hr. were devoted to this test, during which time the engine carried loads of 113.4, 100.4, 79.4, 52.4 and 25.2 per cent of its normal rating for periods of ½, 1, 1, ½, and ½ hr. respectively.

Fuel oil having a heat value of 19,266 B.t.u. per lb. was used with a consumption of 0.495, 0.407, 0.412, 0.449 and 0.652 lb. per brake horsepower-hour, at 113.4, 100.4, 79.4, 52.4 and 25.2 per cent load respectively.

Another interesting point brought out in favor of these engines was the comparatively low outlet temperature of the cooling water. The maximum value of this was 150 deg. F., or less than 100 deg. higher than the temperature of the inlet water.

Lauson Heavy-Duty Kerosene Engines

An account of the satisfactory results obtained with one 80 and one 100-hp. heavy-duty kerosene engine, primarily designed and built for the driving of electric generators in the power plant of their own factory, The John Lauson Mfg. Co., of New Holstein, Wis., was induced to place this type of prime mover, known as the Lauson heavy-duty kerosene engine on the market in addition to its regular line.

These engines which are built with overhead tappets and valves in the heads and operate on kerosene oil, power distillate or gasoline, are said to possess a regulation sufficiently close to enable the ready parallel operation of alternating-current generators driven by them. Gasoline is used for starting purposes until the engine is up to full speed when kerosene may be substituted. This makes them especially well suited for reserve power as they can be started very quickly and will carry full load as soon as they are up to speed.

Special Features

The crank shaft cut from the solid billet is carried in 5 bearings in the engine proper in addition to an outboard bearing to counteract the weight of the generator or belt pull. The main bearings, which are removable without disturbing the crank case, may be adjusted for wear, while the engine is running by means of bolts passing to the outside of the crank case as shown in Fig. 2.

The crank case, in which are enclosed all working parts such as gears, cams, gears for driving the governor and magneto, is of the 2-piece type, split horizontally at the center of the crankshaft.

Extra large water space and cleanout plates are given to the cylinders, the bore of which is ground after seasoning to eliminate warping. The heads of these cylinders, any one of which may be removed without disturbing any other, are completely water jacketed

and carry the valves which seat directly against it, thereby bringing the water in close contact with the valve heads and avoid an undue heating of those members.

The pistons used in these engines are of the barrel type with 4 rings, 3 on its extreme upper end and one on its extreme lower end, and are ground to accurate size.

Forged steel connecting rods fitted with a babbited steel marine type box on the lower end and a phosphor bronze takeup box on the upper end, both having exceedingly large wearing surfaces, are employed.

Like the main crank, the cam shaft is carried in the crank case by 5 bronze bearings and has mounted upon and keyed to it the exhaust inlet and igniter cams of each cylinder. The timing gears are also within the crank case and are held in position on the shaft by means of a taper fit and key. Water for cooling the cylinders and cylinder heads is circulated by a pump mounted directly on the engine and driven by means of a chain and sprocket directly from the crank shaft. Water is admitted to the cylinder on one side directly in line with the lower line of the compression chamber, the cooling water not passing directly through the lower part of the cylinder. This system is claimed to maintain a practically uniform temperature throughout the entire length of the cylinder. Exhaust water is taken out of the top of the head by means of a polished brass manifold.

Governing is accomplished by an enclosed vertical type of flyball governor driven from a bevel gear on the cam shaft. The speed of the engine may be adjusted while running, by shortening or lengthening the rod from the governor to the regulation valves.

The fuel feeding device is of the Venturia Atomizer type, the same as used on Lauson single-cylinder horizontal engines. The principle of this device is to maintain a uniformly high velocity of air through a Venturia tube (see D, Fig. 3), having radial holes in its restricted portion through which fuel is admitted by suction. The governor acts directly upon a 2-ported barrel valve whose ports coincide with ports in the valve housing when the engine is at rest. See F, Fig. 3. When the engine has attained full speed, the barrel valve is rotated by the

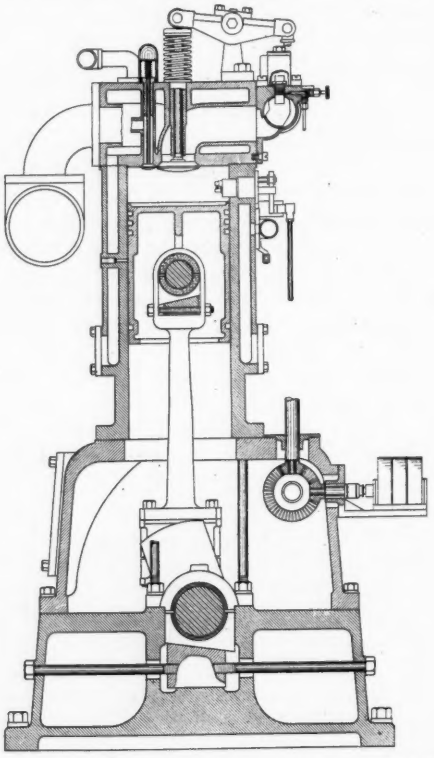


FIG. 2. CROSS SECTION OF LAUSON HEAVY-DUTY KEROSENE ENGINE

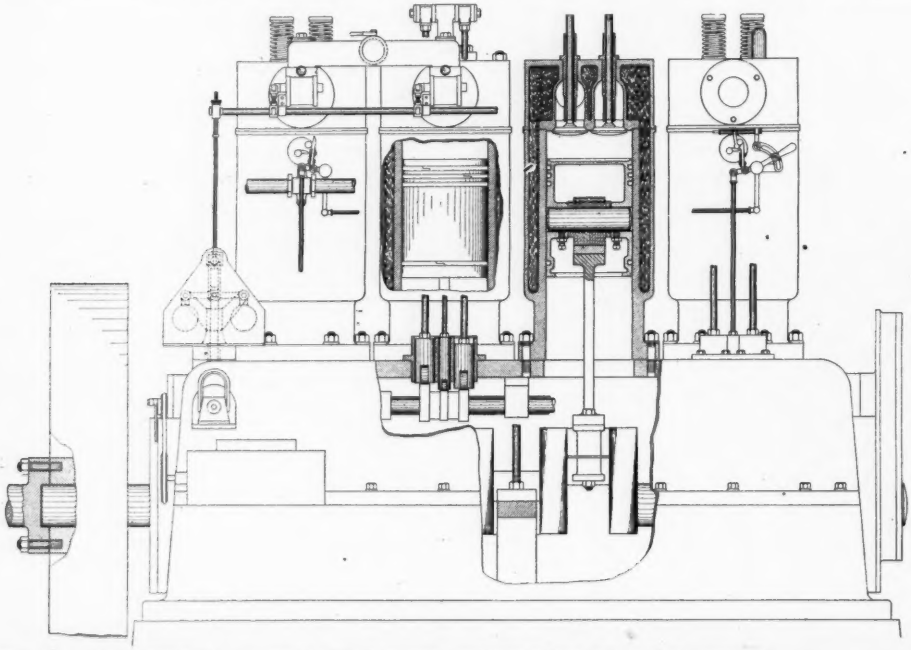


FIG. 1. LONGITUDINAL SECTION OF LAUSON HEAVY-DUTY KEROSENE ENGINE

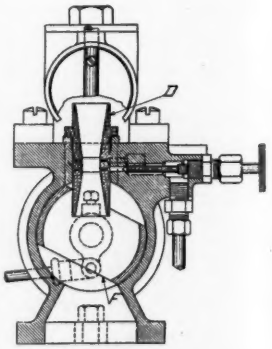


FIG. 3. VENTURIA ATOMIZER TYPE FUEL FEEDER

governor, thereby closing the lower port and decreasing the amount of fuel and air admitted into the cylinder. Simultaneously with the closing of the lower port, the upper port is also closed, deflecting more air through the nozzle and maintaining practically a constant velocity at this point. Adjustment for no load and full load are made by means of the fuel needle valve in conjunction with a butterfly valve in the air inlet. A separate carburetor or atomizer is provided for each cylinder to prevent liquefying of the fuel before it reaches the cylinder. A water feed is provided to prevent premature ignition on full load.

Ignition is of the standard make and break type and is arranged with 2 timing adjustments, one individual and one simultaneous. The simultaneous adjustment is used in starting and is so arranged that all igniters may be stopped by shifting the timing lever. Directly over the igniter is mounted an insulated brass bar which is charged by current from a Sumter gear-driven magneto. The igniters are provided with a spring coming in contact with this brass bar, thus eliminating wiring connection entirely.

The air starter admits air into the cylinder on the expansion stroke, through an automatic air valve in the head. As soon as the engine fires, the pressure within the cylinder holds this valve in its seat, thereby preventing admission of air. The starter consists of a main body, having 4 radial air ports connected by piping to the different cylinders. These ports are covered and uncovered by a rotary disc valve having one port. This disc is held on its seat by the pressure of the air and is free to rotate when the air is shut off. The starter is connected to the end of the cam shaft by means of a flexible coupling. To start the engine, all that is necessary is to turn it to the center and open the air cock, no shifting of cams or gears being required.

Jeremiah Judson, C. E.

Using a Locomotive for a Crane

CHARLIE Spahr came into the lodge room one Saturday evening all bristled up like a maltese cross cat that had been treed by a brindle pup, slammed his hat on the rusty warrior with the broken arm that adorned the top of the little antiquated stove and having thus vented his spleen on something that had no come back, he rammed a liberal charge of Crown Prince Henry into a cavernous calabash and soon had a draft that would give him a life sentence if the smoke inspector were to happen along. We watched the fuse burn closer each second till finally he exploded with:

"Of all the consarned, wooden headed chuckelmucked mollycoddles with a slipped eccentric and no lap that I ever saw, that tin horn master mechanic that sags down the payroll at our dump, comes as near being the small end of nothing whittled down to a point and broke off, that I ever saw."

His nervous safety valve having thus relieved itself, he jumped up and walked around the room a few times, came back, slammed his chair into a new position 2 in. toward the west, and sat down again.

"Well, what's a-eatin' yuh, any way?" broke in McNaughton, as he assumed the defensive. Charlie looked up, "Who? Me? Oh, nothing. I was only scraping in the crankpin on a peanut roaster. But that measly wopperjawed—oh, what's the use," and he ran his fingers through his hair looking for a good place to take out a handful.

"But what did he do, brother, anyway? Shoot your dog, or something?" asked Bob Fenn, as he shifted his feet to an easier position on the rusty stove.

"Do! Do! Oh, Lord! Why he hitched a tackle to a sprinkler pipe to hoist a countershaft into place and when the pipe broke off it was right in line with the main belt. This was in line with the switchboard and nearly so with an exciter and my chest of tools, and there was hell to pay all round. I never saw so big a man with so few brains as he has. He doesn't know enough to step on a bed bug after his wife runs it into a corner."

And while Charlie was getting ready to fly off the handle again, Jerry Judson burst out with his healthy haw, haw, haw, which rubbed the fur the other way on Charlie, but before he could find the right words Jerry cut in.

"Well, sir," and he lit his pipe, "that reminds me of just such a master mechanic as you speak of, over at Celery Valley on the Arizona, Florida & Montreal R. R. To see him and watch him perform, you would think he had to wind up the sun, moon and stars so as to keep the universe going.

"Well, the fool things that he did were enough to make a bully good story, but we will lay that on the table till some other time. But I do want to tell you about a few of them that he did that put me up against it a little to get things out, and finally, how I made a crane out of a locomotive."

"Out of a locomotive?" chorused several.

"Yes, an ordinary little 2-6-0, if you understand railroad phraseology. But to go back a little. I was warned by the 'old man' when he sent me over to Celery Valley to erect the engine; so, being fore-warned, I was sort of fore-armed.

"The job was at the new shops of the A. F. & M. which they had built, or rather were building, out in the country back of the Happy Health Breakfast Balm Food Factory at Celery Valley.

"When our engine arrived on the job, nothing would do but they must deposit it right out in the field in the sand which was dry and shifting, so that it soon piled up around and in the boxes and parts. The frame seemed to be especially industrious in getting out of sight. There were thousands of ties within 200 ft., but that would have been work to put a few of them under the engine when it was unloaded. So this was the proposition when I landed there one afternoon in July.

"The contract read that we were to 'furnish all labor, material, tools, fixtures and appliances, to erect the engine and place it in operation and then run a 50 per cent overload test for 8 consecutive hours.'

"While I was debating how I was going to get those heavy parts out of the sand, and up that hill into the powerhouse a man came over and asked if I had hired my 'gang' yet, which I hadn't. He was the man who was erecting the cranes in the shop and owing to the cussedness of inanimate things, when he was raising the large 125-ton crane in the main shop, the 4-in. rope broke just as he was about to swing the mammoth crane around onto the tracks.

"Well, when I arrived, he had just cleaned up the muss and shipped it back to the factory for repairs, and as there was nothing more to do till the crane was repaired, he was about to lay off his gang. He said that he would consider it a favor if I would take his gang and keep them busy so as to hold them together till he was ready for them again. This was a good streak of luck, as the boys were used to handling machinery.

"To make matters better, he threw in all his ropes, chains, tackles, rollers, sledges, etc.; in fact, he gave me the key to his big tool boxes. We took shovels and went out prospecting for the engine frame and soon struck 'pay ore.' To get it out and on skids was a puzzler. I saw a switch engine over on the siding blowing off steam like Spahr did here a few minutes ago, and I went over and made a dicker with the engineer to give me a lift. Price, a handful of cigars, real ones.

"The concrete smokestack was in the right place for the first try. So making a hitch around it I strung a tackle from it to the frame in the sand and ran the free end of the rope through 2 snatch blocks, one chained to a girder near each of the 2 doors on opposite sides of the powerhouse. I gave the engineer the 'high ball' and the frame came right along. In fact, it came so well that I decided skids were not necessary, although it plowed quite a furrow in the soft sand.

"We stopped long enough at the door to wash the sand off with a hose. Didn't it rust it? After an engine has basked in the sunny side of a breakfast food factory for 3 months, a hose will not add much rust to what it already has.

"The cylinder came in the same way and then we tackled the shaft and wheel. There was no crane in the engine room but the steel work was pretty well designed. We strung a chain between 2 trusses with a snatch block halfway, and with the locomotive we hoisted up 2 6 by 14 yellow pine timbers, which we arranged convenient to raising the shaft with the alternator on it.

"We snaked in the lower half of the wheel and put it in the pit and then we used our iron horse and the tackle to bring the shaft up the hill and into the engine room. This was pretty rusty, although it was well slushed when it left the shop.

"Here was where we wanted to move things quite slow. So with the crane man's ropes we lengthened our rope so that the switcher could get over on another track that ran off at quite an angle, thus reducing speed at the blocks. We rigged chain tackles at each end to act as guide falls, so that we could let the shaft down level and not bind the frame between the crank and the collar.

"I gave the engineer the once over, and away we went, barely moving, but the ropes began to tighten and creak and finally the shaft and alternator began to rise and kept on till we used the guide falls to swing it into place over the bearings. By this time, the switcher was fully 100 rods away.

"The yard master stood in the doorway for us at this stage of the game as we might not want to go down as fast as we went up; but so well did the boys handle the tackles that we never stopped till the shaft lay in the bearings.

"After a delay, while we squared up the shaft and grouted the outboard bearing, we dragged in the top half of the wheel; but here was another problem, for we had not only to hoist the wheel into place, but to look out for the alternator on one side and the switchboard on the other; however, by a series of guide falls (having no less than 3 on at the same time), we carefully hoisted the wheel with the switch engine on the 'slow speed siding,' as the boys call it, and rearranged them so as to guide the wheel in its descent onto the shaft.

"This whole problem worked out beautifully without an accident, and it saved us a lot of good hard back-breaking labor. Even the piston, cylinder head, etc., were handled by the switcher, for we had no light winch as the only one they had happened to be under the 125-ton crane when it came down.

"Where does the master mechanic come in? Well, he comes in in view of the fact that we didn't break off any sprinkler pipe and also that he broke his side rods when he found out that it was up to him to make a water rheostat to supply the load while we ran his 50 per cent overload test."

"You fellers square around against the wall there and shut up. We are going to have a meeting tonight." And Pres. Ellis banged the desk with the gavel.

Economizers

WHILE but a short time ago, economizers were considered more as a refinement in power stations than an actual necessity, we find their real usefulness becoming more and more evident as practice changes. With the introduction of motor-driven auxiliaries, such as boiler feed, condenser and house service pumps, and the consequent reduction of available exhaust steam for feed water heating, and with the decrease in temperature of condenser discharge due to high vacuum, some means must be provided for the proper heating of the water before being introduced into the boilers. These conditions bring the economizer forward as more necessary as well as advantageous in actual service.

IF GAGE GLASS fittings are not quite in line, the glass may be bent slightly near one end to bring both ends true with the fittings. A gasoline blow torch may be used to heat the glass, which should be turned in the flame, care being taken not to get the glass so hot that it will run or bulge or lose its shape. Extra heavy glass is best for the purpose, a piece of wood being put into one end as a handle to avoid burning the fingers. Place the torch near the fittings which are to receive the glass, so that if the bend is not right on first trial, the glass may be reheated before it has time to cool. When right, allow the glass to cool before putting it in place or the contraction when cooling will break the glass and spoil the job.

Selecting a Coal*

EFFECTS OF COAL CONSTITUENTS ON HEAT VALUE AND COST OF STEAM MAKING

IN THE manufacture of electricity or steam, coal represents from 10 to 50 per cent of the cost of the finished product, hence it behooves the plant operator to give this careful and detailed consideration. In a general way, passing from the East to the West, there is a rather constant increase in the percentage of volatile constituent in the coal, the highest thermal value being found where the volatile appears from 17.5 to 20 per cent, although in some of the eastern fields this may increase to 35 per cent with a decrease in heat value of approximately 5 per cent. In the Central States coals, from Ohio, Indiana and Illinois, the volatile may increase from 36 to 45 per cent with a decrease of 15 to 30 per cent in thermal value below the value for the highest eastern coal.

There may be, however, a considerable variation in the makeup of coals without great change in the heat value, as, for instance, in 2 samples. The first had 8.93 per cent moisture, 36.53 per eent volatile, 33.76 per cent fixed carbon and 20.78 per cent ash, with a heat value of 10,001 B.t.u., while the second had 3.53 per cent moisture, 20.75 per cent volatile, 47.85 per cent fixed carbon, and 28.87 per cent ash, with a heat value of 10,264 B.t.u. In a second pair the moisture of the first was 4.49 per cent, volatile matter 40.55 per cent, fixed carbon 47.43 per cent, and ash 7.53 per cent with a heat value of 12,958 B.t.u., while the second sample had moisture 3.24 per cent, volatile 17.46 per cent, fixed carbon 66.69 per cent, ash 12.61 per cent, and a heat value of 13,129 B.t.u.

The setting in which the coal is to be used must also be taken into account and it is probable that the second of the 4 samples mentioned would be more satisfactory than the first with the average boiler setting because of the higher fixed carbon and lower moisture which would work out better under average furnace conditions as now found. It should be borne in mind, however, that where coals of widely different characteristics can be obtained at equal cost, and one of them will give better economic results than the other, a change of equipment in the furnace may be possible at a comparatively small expense which will make the coal with the better heat value work as satisfactorily as the one which may now be in use.

Coal Sizes

PRACTICALLY all steam coals in the central western fields are of the nut size or smaller, except where run-of-mine is used. The sizes now commonly on the market are as follows: No. 2 or nut coal passes through a 1½-in. screen and over a 1-in.; No. 3 or small nut passes through a 1-in. screen and over a ¼-in.; No. 4 or pea coal passes through a ¾-in., and over a ⅜-in.; No. 5, called duff, passes through a ⅜-in. screen.

For hand firing with proper grates, draft conditions, baffling, etc., high efficiencies and continuous overloads may be carried with the No. 5, or with raw screenings; but where high overloads are demanded a uniformly sized coal, such as No. 4, No. 3 or No. 2 will generally give the desired results to better advantage. The higher cost of these coals will, however, make the cost of steam making great and it will likely be better to change the arrangement of the furnace so that the cheaper size of fuel may be used and yet get the desired results.

Coal and Stoker Types

IN A general way, for stoker firing, it is found that the underfeed types will give the best general results with a coking coal such as West Virginia Gas, Pennsylvania Gas, Pittsburgh No. 8 or Pocahontas. For the overfeed type of stokers either a coking or noncoking coal may be used, the free burning coal having less tendency to slide. For chain grates a free burning or noncoking coal with high ash may be easily handled. This specification is very general and any type or make of stoker will handle or burn any coal if it is given the right conditions for that particular fuel.

Chemical constituents of the ash are a great factor in securing the best results. With certain combinations it may be nearly impossible to secure satisfactory continuous operation because of the prevention of proper distribution of air through the fuel bed and the formation of slack or glassy clinker. The amount of moisture contained also has an important bearing, both as determining the amount of heat used up in converting it into steam and also in its effect on the clinker formed.

Mine Conditions

WHERE POSSIBLE, it is desirable to inspect the mine from which steam coal is shipped because the conditions at the mine may determine quite largely the quality of coal which will be supplied. If the mine is poorly drained, coal as sent to the shaft and placed on the cars may be dripping with water; if miners are careless the fine coal and clay from the under cutting may be thrown into the mine cars instead of being thrown into the dump. There may also be slate bands in with the coal, and there will be question whether the slate is eliminated before the coal is shipped. Inspection and care on these points may make a difference of 1 to 2 per cent in the ash found in the coal as delivered. There is also, in the case of large purchases, the question whether the mine is in position to furnish the grade of coal required and in the amounts required, and inspection of the loading sheets and output of the mine for the past year will settle these points.

After all points are taken into consideration, however, the final test of the suitability of a fuel for the plant is an actual trial under everyday operating conditions with the output carefully measured and the coal used carefully weighed. This will give the real operating efficiency under plant conditions. It should always be kept in mind, however, that plant conditions may be changed so as greatly to improve the results if records are kept, losses hunted out and their causes determined.

Heat Value Charts

AS A method of determining what may reasonably be expected of a coal when the composition is known,

*From a report of the Station Operating Committee of the National District Heating Association.

the 2 charts in the Practical Reference Tables are valuable. The first gives the means of determining approximately the evaporation per pound of coal from and at 212 deg; the second gives the means of determining from the evaporation and price of coal the cost of coal per thousand pounds of steam from and at 212, and by a secondary calculation the cost per actual thousand pounds of steam made, and shows also the reasonable results to be expected from a considerable list of coals and the composition which these coals should show on analysis.

As an example, the coal from Duquoin, Perry County, Illinois, is worked out. Analysis on chart II shows that there is 82 per cent combustible, 18 per cent ash, moisture and non-combustible material and of the combustible 47.5 per cent is fixed carbon and 34.5 per cent volatile matter. Going now to chart I, we find at the top the division of 82 per cent combustible in the coal, and follow vertically down the dotted line until we reach the horizontal line passing through 47.5 on the scale at the left of the chart. This is the fixed carbon in the coal and following up along the slanting lines we find that the fixed carbon is 58 per cent of the combustible.

Following the line which slants upward from left to right, we reach the 58 per cent point at the top of the chart, then follow down vertically until we intersect the curve marked "Efficient B.t.u.," and running horizontally to the left-hand scale in the column headed B.t.u., we find that the reading is 9200 as the efficient thermal units per pound of combustible.

As the coal has but 82 per cent combustible, we follow down the lines slanting downward to the right until we intersect the 82 per cent vertical, then go horizontally to the right-hand scale and in the column headed "Pounds of Water Evaporated" we find that an evaporation of 7.8 lb. of water from and at 212 deg. may be expected per pound of coal.

This chart is based upon efficiency which would be considered high class operation from boiler and evaporation standpoint, and, of course, if the operation is not up to this standard a lower evaporation per pound of coal will be found in the plant.

The top curve on chart I is based on DuLong's formula for figuring the heat units in the combustible. The dotted curve marked "Efficiency of Combustion" shows what should be obtained for the different kinds of coals under good conditions as estimated by Prof. Kent. Multiplying the values in the upper curve by those of the efficiency curve, we get the curve of Efficient B.t.u.

Going now to chart II, if we start on the left-hand scale with 7.8 lb. of water evaporated and assume that the coal costs $2 a ton, we pass to the right horizontally until we intersect the $2 slanting line, then vertically downward to the bottom scale and find that the cost of coal in cents per thousand pounds, from and at 212, would be 14.5 cents. If we assume that the water enters the boiler at 62 deg. F., and the steam is generated at 150 lb. gage without superheat we find from the diagram for evaporation factors, at the top of the chart, starting at the 62-deg. point on the left-hand scale and following horizontally to the intersection with the 150-lb. diagonal line, then passing vertically upward, that the factor of evaporation will be 1.2 or 120 per cent, hence the actual cost of steam per thousand pounds will be 20 per cent greater than the cost from and at 212, or multiplying 14.5 by 1.2 we get approximately 17.5 cents as the actual cost for coal burned per thousand pounds of steam made.

From the list on the right-hand side of chart II, it is possible to determine at once, when the known composition of a coal corresponds to one of those indicated on the list, what the evaporation and cost will be without the use of chart I. As, for instance, in the case of Hocking Valley, Ohio coal, if we follow the index line from the list of coals to the chart we see that the evaporation should be 8.1 lb. of water per pound of coal, and if we assume a cost of $4 a ton the coal cost per thousand pounds of steam from and at 212 will be found at 27.5 cents. The factor of evaporation and actual cost per thousand pounds can be determined for any set of conditions as in the previous case.

It will be noted from the B.t.u. per pound of combustible on chart I, that, as already stated, the highest thermal values are given by coals having approximately 20 per cent of volatile matter in the combustible, range being from 16 to 24 and fixed carbon being from 76 to 84 per cent of the combustible.

As indicated on chart II, the basis for the chart was furnished to the committee by W. H. Schott of Chicago; but the evaporation factors and cost of steam per thousand pounds was worked out by the committee.

"By repairing your cuts you cut your tire bills," says R. S. Wilson, Manager Service Department, The Goodyear Tire & Rubber Co., Akron, Ohio.

"A little glass cut, a nail hole, or any abrasion that penetrates the rubber tread to the fabric of the tire, opens a way for dirt and moisture to creep in. In many an apparently perfect tire, when removed from the wheel, and deflated, is found a loose tread, under which are dirt and moisture, rotting the fabric.

"If you have ever found a tire in this condition, you know you have had a strong temptation to call it defective. Did you ever select a nice, rosy apple, apparently a perfect specimen, and discover, after the first bite, that it was pitted with worm holes? If so, you were tempted to call it a poor apple, and yet, generally, investigation would have shown somewhere, down on the side, a small hole, where the worm crawled in.

"Almost without exception, the tire having a loose tread and rotting fabric, is no more at fault than the apple into which the worm bored its way.

"As the tire revolves a suction is produced, which draws particles of dirt into the cut. Gradually these particles work under the rubber, grinding and cutting it from the fabric. If neglected, this grinding process will work around the tire and separate the whole tread from the fabric. The fabric under the tread soaks up some of the moisture, which causes it to weaken, and a blowout soon follows.

"A tire cut is the most common and most destructive of all tire troubles, and yet, is the easiest to remedy if taken in time. It is a good plan to look over your tires every few days. It will pay you to repair any cuts, however insignificant they may appear.

"You can do this quickly by cleaning out with gasoline and filling in with Quick Repair Gum."

LETTERS DIRECT FROM THE PLANT

Cash Paid For Ideas Accepted. Sketches Desirable.
We Make The Drawings

Some Schemes Used in Power Plants

THE VALVE seats in the water end of a hydraulic pump were all loose and, of course, forced the valve, seat and all, up so it couldn't pump. I took the caps off the water end and made a hook out of 3/8-in. rod and pulled the valve seat out, cleaned the outside surface with a small flat file and tinned it with a heavy coat of solder.

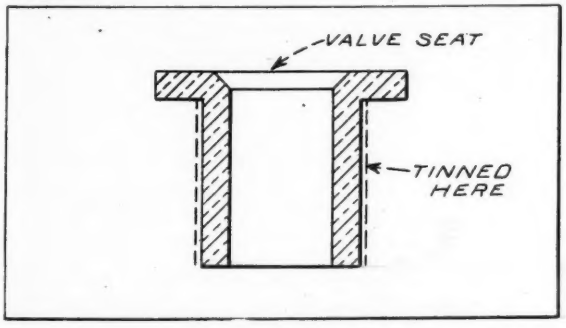


FIG. 1. VALVE SEAT

After I dressed it a little I made an oak mandrel and drove the seat down hard. I fixed all of the valve seats this way, put the pump together, started up and it went to pumping.

I have also used this method to make the water barrels tight in boiler feed pumps that have worked loose. Of course, these valves and also barrels were made of brass.

Once I had charge of a small horizontal boiler that lacked draft at times, so I made a blower which beats

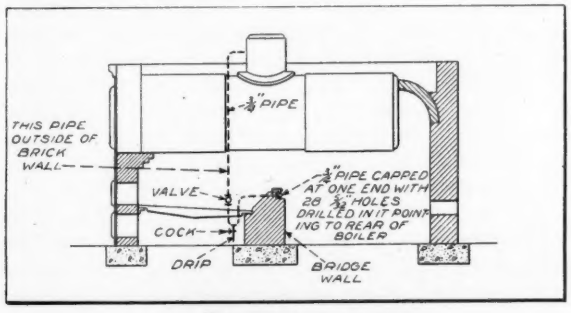

THIS PIPE OUTSIDE OF BRICK WALL
3/4" PIPE
1/2" PIPE CAPPED AT ONE END WITH 28 3/32" HOLES DRILLED IN IT POINTING TO REAR OF BOILER
VALVE
COCK
DRIP
BRIDGE WALL

FIG. 2. STEAM JET PIPING

anything else I ever saw for cheapness and results.

Take steam from dome of boiler so that it will be dry. Put valve in above drip.

Take 3/4-in. pipe whose length is the bridge wall's width. Drill small holes in it, say, every 4 in., inside of setting. Punch a hole through the boiler wall and insert perforated pipe.

I took out the back course of brick, put pipe in and placed brick on top of the pipe, to protect it from the flames. It has given me great relief. Later on, I changed it and rigged up an old whistle valve with a lever convenient for me to operate with my foot. When I was putting on coal I could put one foot on the pedal and keep from nearly getting roasted by starting my blower. The drip should always be open, as the

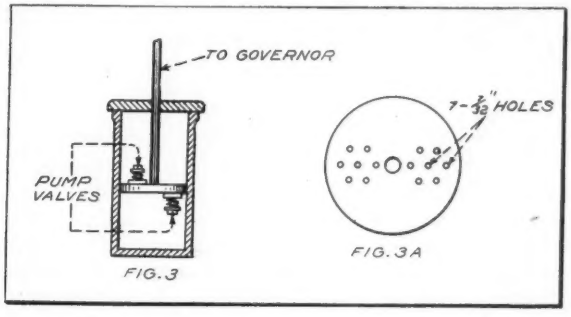


FIG. 3. GOVERNOR GAG POT AND FOLLOWER HEAD

pipe may be full of condensed steam. If this ever did the boiler any harm, I never could find it out.

About 3 yr. ago, I had considerable trouble with a gag pot on a Corliss governor. I used thick oil, thin oil, hot oil, cold oil and water to no avail. Then I got 2 valves out of a small duplex pump that was in the scrap pile; I took the follower plate out of the gag pot, laid out a circle, first on one side, then on the other, drilled 7 7/32-in. holes in each circle and one for the stud to

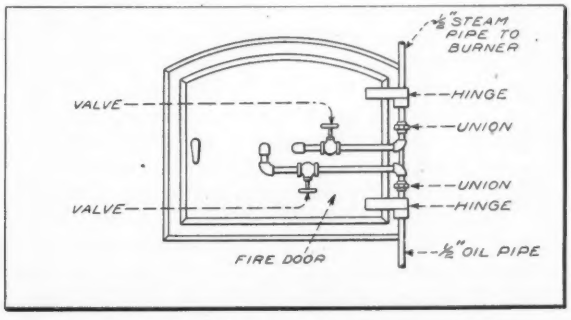


FIG. 4. FIRE DOOR FITTED WITH OIL BURNERS

screw in. Then I made a couple of weak springs and put the pump valves in as illustrated. Afterward I cut off the reach rod from the gag pot to governor, so that when anything happened, the bottom valve would not strike the bottom of the gag pot. I weighed the reach rod and follower before and after I did this.

Counting what I cut off the reach rod and the holes I drilled, I was a little light, so made some babbit rings and fastened them to the rod above the gag pot to make the whole thing have the original weight. Since putting this on, I never saw an engine behave better. If the follower head is a pretty snug fit, you won't have to use oil of any kind, as air does the trick.

Once I was asked how I would pipe up an oil burner so it could be inspected when the boiler was in service.

I took the bolt out of hinges and reamed holes out a little so I could use ½-in. pipe in its place for door to swing on, got some extra heavy pipe and put in place. I tapped a hole and threaded it for a ⅜-in. set screw in lug on boiler front to keep pipe from turning. Next, I got 4 Jefferson elbow ground joint unions and tapped them for a small set screw to keep union tight, that is, to keep it from unscrewing when doors were opened for burner inspection. I fixed the oil pipe the same way and no leak has developed yet. When getting up steam as at this place the door with burner can be opened and a piece of sheet iron used instead, so we protect our burner from getting overheated. FRED V. BROADAWAY.

Vacuum and Temperature Discussion

IN THE discussion of vacuum and temperature in the July 1 number, A is right. The discharge water may be any temperature below that due to the vacuum in the condenser. The discharge water may be at a temperature of 40 deg. F. and still the vacuum in the condenser may not be more than 22 in. of mercury. The temperature of the discharge water has nothing to do with the vacuum in the condenser as long as the temperature of the water is below that temperature due to the vacuum.

The statements in the discussion apply to a jet condenser. In this type of machine, the temperature is more closely related to the vacuum than in a condenser of the surface type. It is impossible to get a vacuum above the temperature corresponding with the discharge water; that is, you can not get a vacuum of 28 in. of mercury and your discharge water at a temperature of 135 deg. F. In this respect I agree with B. But where the temperature is lower than the temperature due to the vacuum it would be poor policy indeed to try to tell what vacuum there is in the condenser by noting the temperature of the discharge water. A good way to tell the vacuum in the condenser is to insert a thermometer which is known to be reliable into the condenser head in such a place above the water that only the vapor in the condenser is in contact with the bulb. This will tell within 1/10 in. of the correct vacuum in the condenser, for the temperature of the vapor will be that temperature due to the vacuum in the condenser. Then, with the aid of a steam table, the vacuum may be determined.

A. P. Sitton writes that he has had his fill of trouble with graphite feeders. The U. S. Graphite Co. makes a feeder which sells for a small sum of money and does its work to perfection. The writer has one of their feeders in use for the last 3 yr. and has no complaint to make. I am using a pint of ground graphite in 24 hr. for 2 200-hp. water-tube boilers. This small amount of graphite prevents any scale forming in the boilers. The boiler attendant blows the boilers down twice in 24 hr. Boilers are on the line for 85 days and when taken off are perfectly clean. The feeder is nothing but a plain receptacle about 6 in. in diameter and 12 in. in height with a filling plug on top and a drain valve in the bottom, 2 ½-in. pipe connections, one for the inlet the other for the outlet. All the attendant has to do is to put in the pint of graphite in the morning, open the valves and the feeder will do the rest. The system A. P. Sitton uses is expensive to install, takes time to look after, is apt to get out of order and, worst of all, takes money to operate it.

S. P. Baird says that letting some air into the suction pipe of a pump in order to make it run smooth is something new to him. Mr. Baird has surely had in use or has seen in use an air chamber on the suction side of reciprocating pumps. Letting air into the suction pipe serves the same purpose as using an air chamber. Initial cost is nothing, but the operating cost will amount to quite an item if the reduced capacity of the pump per pound of steam used is considered. The air is trapped in the valve chamber and water cylinder and serves as a cushion and takes up the shock due to the high velocity of the water entering the pump, which velocity is caused by the high piston speed of the plunger. This is the reason that the pump was running smooth without pound or shock. A. C. RUHL.

Some Pulley Repairs

A PLANER OPERATOR, in trying to tighten the 2 set screws in a cast-iron pulley located on a countershaft, stripped the 2 threads in the hub of the pulley by using too large a wrench. After he found the screws would not hold, the pulleys and countershaft were taken down, but in trying to remove the damaged pulley from the shaft it was found it could not be done without breaking the pulley, for the set screws, in getting loose, had marred the shaft.

A quick repair was made in the following way. The old set screws were ⅝-in. The 2 holes in the hub of pulley were enlarged to fit a ¾-in. tap. But in drilling the holes larger, the drill was also run partly into the shaft, then the threads were started with a ¾-in. taper machinist's hand tap, then followed up with a plug tap, while a bottoming tap finished the threads to the bottom of hub. Then ¾-in. set screws were used in place of the ⅝-in. as before. Making the repair this way saved the work of removing the pulley from the shaft, which perhaps would have required cutting the shaft off on both ends of the hub, then drilling it out of the hub.

I have found it to be bad practice when a pulley held to the shaft by set screws gets loose so the shaft turns in the hub, to try to tighten the pulley again with the old screws, as the sharp edges of the set screws may be ground down when they will not hold, no matter how tight they are drawn up. It is better to replace them with new screws at once.

At one time a new planer was installed. After all arrangements were made to put the planer in operation, it was found that the pulley on the line shaft driving the countershaft, on which there was a shifting belt, had a crowned face in place of a straight face, as is necessary for pulleys on which a shifting belt runs. As there was

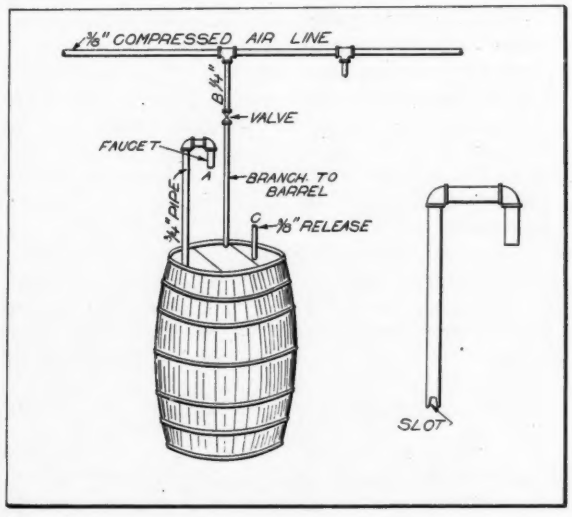
not the time to disconnect the line shaft and remove the pulley so as to send it to a machine shop to have the crown taken off, it was decided to overcome the trouble in the following way. The belt was thrown off the pulley. As the line shaft was driven by a motor, this was started, then a very coarse file was used to remove as much as was possible of the crown on the pulley, at least so much that the belt would stay on either tight or loose pulley on the countershaft, when shifted, as it was thought at that time that later on when there was the time the pulley could be taken off the shaft and sent to the machine shop to have the crown removed entirely; but it is now 8 yr. ago, and it has not been found necessary to send the pulley to the machine shop. H. A. JAHNKE.

Compressed Air for Handling Oil

ACCOMPANYING is a sketch which will explain itself to anyone who has compressed air at his command.

I am in charge of a compressor plant and also all of the oil used by the company. As I was often alone in the engine room when the various barrels arrived, I had either to call in help or, oftener, set them up alone.

It is no easy task to set a barrel of oil up 1½ ft. from the floor; so I tried the following scheme. I set a barrel of oil on end, then tapped 3 holes in the top head, ¾, ¼ and ⅜ in., or large enough to make a tight fit for these sizes of pipe. The ¾-in. pipe I run to the bottom, after cutting 3 notches in the lower end with a hacksaw to



PIPING TO OIL BARREL

allow oil to enter between the lower end of the pipe and head. Next, I ran a ¼-in. compressed air line to the barrel, with valve at a convenient position, and inserted a ⅜-in. nipple as a release; my reason for this was, to let the air escape when the can is filled with oil, thus stopping the flow immediately.

The first time I tried this, it worked fine. It can be used equally well for valve oil, if a little more care is taken, so as not to get too much pressure, which might cause the barrel to spread and leak. Not over 5 lb. will be needed to give a good flow. I simply open the air valve a little, put the can under the spout, and press my thumb over the release; then, if more pressure accumulates than is needed, a little can be allowed to escape. When the can is full, by removing the thumb from the release, the pressure will drop and the oil will stop flowing instantly.

The release is necessary, for when the oil gets low, there will be enough air in the barrel to keep the oil flowing after the air valve is closed. F. H. BLIVEN.

Engineering in a Veneer Factory

MY FRIEND, Onwald, came into my engine room hurriedly one day and said: "Say, could you meet me at the veneer factory tonight when you shut down? I have had the job there for 3 days, but I'll have to give it up unless you can do something for me."

"Why!" I said, "you were a big fool to take that job. Lumm went to the bug house out of it and Swasey stayed there only a week and he left a good job to get it."

"I know it; that is what is the matter, but they pay $3 more a week than I got at the dye works, and that will make a difference in our house from merely existing to luxury."

"What is the matter anyway?"

"Oh, I don't know. The foremen are yelling that they haven't enough steam for their dry rooms and glue heaters, and if I open up the valves to them I can't keep up enough to turn the engine over, and I am sweating like a bath rubber, poking in veneer slabs and soft coal. Last night I went home so tired I could not eat my supper."

"Your case seems to be bad, Al. I'll be up there about half past 6."

"All right, I'll have to beat it right back. I left one of the cleaners poking in veneer sheets and he may have the place on fire by this time."

At 6:30 I met Al on the steps of his factory and we made a tour of the plant; the workmen having left, we had the building all to ourselves. I found that the glue was heated in open water baths by blowing live steam into them from a ¾-in. pipe. The dry rooms were piped up with return bend fittings, necessitating high pressure to force the steam through them.

The veneer was steamed with high-pressure steam blown into a box-like affair covered at the ends with burlap. The factory was heated with high-pressure steam, etc.

I outlined the changes that would be necessary to use exhaust steam for all these purposes, made a rough estimate of the probable cost, and promised Al that I would be at the factory the next day at 10 a.m. to meet his "boss."

When I called, next day, the engineer was still shoving armfuls of veneer into the roaring furnace and wiping perspiration from his brow. After getting the man of all work to take his place in front of the furnace, we went up stairs to see the boss. Al introduced me, telling about my trip of inspection the night before and what I recommended. The foreman was in the office at the time and at once "butted in."

"No good, no good," said he, "we tried that once before, and it would not work. I won't have it."

I ignored him and addressed myself to the boss. "Now," I said to him, "I don't know how much your foreman knows about his business, but I know mine; it is steam engineering, and I will guarantee that I can do as I say.

"You are heating your water there in open tanks and cannot get over 212 deg. I can get that with exhaust steam and I will make the circulation in these tanks better and heat the water more uniformly; your men can open the valves as wide as they like and there will be no fighting about it. I will put headers in place of some of the return bends in the dry rooms and rearrange the ventilation and you will dry your work better than you do now."

"But," said the boss, "you see the foreman won't have it. What can I do?"

"I know what I'll do," broke in Onwald at this point. "If I don't get these things, I quit right now."

"Oh, don't be too hasty, Al," said the boss. "What will these things cost, Mr. Meinzer?"

I told him $50 would cover what we had in mind at present.

"Oh, if that is all, go ahead." Then he added in an undertone to me: "He will be satisfied, anyhow. We used to get along all right, but for the last year we have had lots of trouble. We have added more machines and taken on more help and as they are all paid piece work, everything is being run to the limit and the men kick if the engine slows down or they can't get steam."

I ordered a cheap back-pressure valve and the necessary fittings to connect to the exhaust piping of the engine, and rearranged the piping about the factory so exhaust steam was made to supply everything that would work on the temperature and pressure that I expected to carry. This work was done at night and on Sunday. On the following Monday morning, at 9 o'clock, I went around to see how things were going.

On entering the office, I asked the boss how things were going.

"As far as I can see, everything appears to be all right."

"How does the foreman like it?"

"Oh, he hasn't much to say about it, but he will come around all right; he hates to admit it."

I visited the vats about the factory, and went down to the boiler room and found the engineer *sitting down;* what do you think of that? His face broke into a wreath of smiles when he saw me.

"They can open up their valves all they like now," said he. "I left the valve wide open when I started up, and I blew the water out of their blooming tank. You ought to have seen the guys run. They thought the place was going up; steam was everywhere. Send in your bill just as soon as you like and charge them double time for that night and Sunday work; they will pay it all right."

The following week, Al surprised his boss by telling him he did not need any more coal when he was asked if he had room in the bin for a 5-ton truck load, and they haven't used a pound of coal since—a clean saving of $22.50 a week on this item. When the boss heard this, he voluntarily raised Al's pay $3 a week.

Later, I put in a grease extractor, pump and receiver, exhaust steam injector, exhaust head and new lubricator, each time making a saving and securing an increase of pay for Al, until he was getting $28 a week, having started at $18.

They had sawdust and firewood now to sell. When winter came, the heating was done with exhaust steam, the men were comfortable, more and better work was turned out and the firm made more money. The only regret of the boss is that he had not met Al 10 or 12 yr. ago. The foreman is converted.

W. T. MEINZER.

Remedy for Pump Trouble

THE PUMP described by Mr. Baird in the July 1 issue, as working easier on the admission of a little air into the suction pipe, was probably running at an excessive speed. The maximum speed at which a pump of the kind described will work smoothly, is limited first by the condition of the suction pipe.

A very long pipe or one of too small diameter or one in which are a number of bends, will have the effect of restricting the flow of water. When the pump is speeded up, the barrel does not fill and on the discharge stroke the piston strikes the oncoming water, producing the slamming sometimes heard. To remedy this, recourse is sometimes had to admitting air to the suction pipe, the amount being controlled by a cock or a "snifter" vent like the one described by Mr. Baird. These are but makeshifts, however, and their necessity indicates the need of a larger pump, a reconstruction of the suction line, or a reduction of the suction lift.

The writer once had an experience with a pump which had 4 elbows in the suction line. When speeded up, the pounding was such that the pump was loosened from its foundation. As a temporary remedy, a valve was fitted to the suction pipe, allowing a small amount of air to enter with each stroke of the pump. This reduced the pounding, but the pump ran by jerks, due to the air being alternately expanded and compressed. When the opportunity came, we made some changes which permitted the removal of 2 of the elbows and by placing a suction air chamber near the pump, we got it to running nicely.

C. O. SANDSTROM.

Steam Pipe in Tension

AN EASTERN steam power plant designer has recently begun computing his main line pipes so they will be in tension when installed, and when cold, but not in tension when heated by steam. That is, he does this if the pipes line in a straight line. He figures that by so doing there is no compression whatever in the pipes when under steam and when such stresses should certainly be minimized.

This designer uses the coefficient 0.000,004,7 in making his computation so that, roughly, for each 10 ft. of pipe, where superheat is used, he makes the "cold" pipe 1/10 in. short.

This method has another important advantage in that where a pipe renewal is to be made, the replaced pipe is easily dropped out and the new pipe inserted. There is plenty of clearance from end to end of the pipe line.

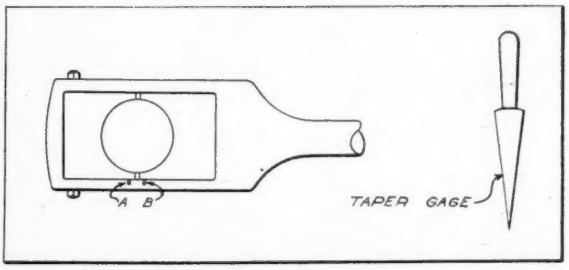
N. G. NEAR.

Successful Kinks From The Plant

For Saving Time, Work and Trouble

Keeping Tab on Crank Pin Boxes

IT MAY be of interest to some engineers to find the wear on the crankpin boxes on their engines. This depends upon the kind of box and the load on the engine, and it may be done by putting 2 pins in the brasses, as at A B, and measuring the distance between

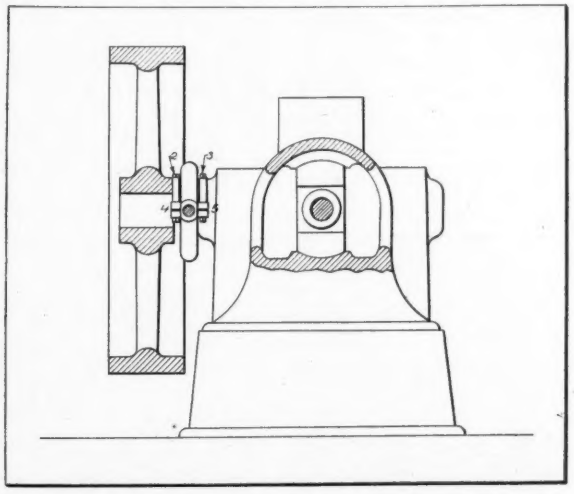


PINS IN CRANKPIN BRASSES TO KEEP ACCOUNT OF WEAR

them with a micrometer or gage after each keying up of the boxes. A record of these distances and dates will show conclusively the amount of wear which takes place over a given period. A. L. JOHNSON.

Making Bolts More Accessible

ONE OF the high-speed engines in my plant is fitted with an eccentric which gives motion to the piston valve. As it revolves at a high rate (for an eccentric) a cast-iron cover is provided to keep oil from being thrown



ECCENTRIC STRAP COVER FASTENED WITH LONG BOLTS

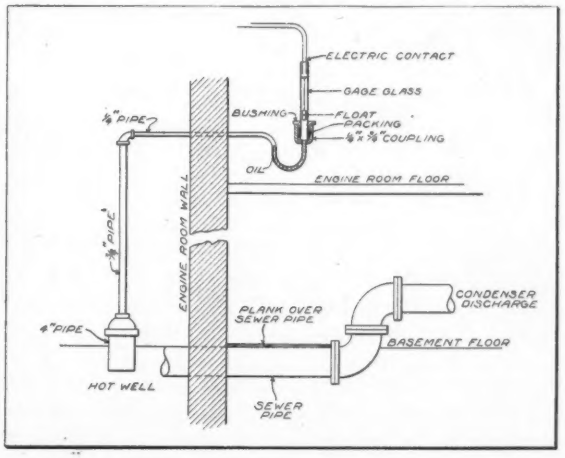
out by centrifugal force. A section of this engine, through the flywheel, is shown in the illustration. The eccentric cover is between the hub of the flywheel and the right-hand main bearing, where it is not accessible. It is made in halves, and was held together by 2 bolts as shown at 2 and 3. These bolts were formerly only long enough to go through the lips at 4, hence it was difficult to turn them when it became necessary to remove the cover. The nuts could not be turned, hence they were held by a suitable wrench, while the bolts were unscrewed out of them.

To improve this condition, I secured much longer bolts of the same diameter, and had some pieces of iron pipe squared in a lathe. When the bolts were put through these, and inserted in their proper places, the heads were much more accessible, and now they can be turned with a small monkey wrench, while the nuts are held stationary. I have applied the same device to the tops of water columns, and find it very convenient. There are other places in a steam plant where this idea can be utilized for the benefit of the engineer in charge, or whoever keeps the machinery in repair.

W. H. WAKEMAN.

Condenser Discharge Indicator and Alarm

WE USE salt water for condensing and at low tide do not get enough of it, so have to use city water to help out. When this is being used, we sometimes get more than the discharge pipe will carry away and the water will raise above a plank that is over the sewer and flood the basement. The same thing occurs also at high tide.



GENERAL ARRANGEMENT OF DISCHARGE PIPING, HOT WELL INDICATOR AND ALARM

We placed a 4-in. pipe over the hot well and reduced to ¾-in. pipe, then to ¼-in. pipe, and made a U, as shown, with gage glass attached and filled the U with oil. The action is as follows: As the water rises in the hot well, the air trapped in the vertical pipe is caused to rise, forcing the oil out of the U pipe up into the gage glass,

thus showing the height of water in the well in the engine room. The oil rises and falls according to the height of the water. In case one does not happen to see the height of the oil, there is a cork float in the glass that makes a connection with an electric bell which rings and gives warning. J. G.

Kinks for the Plant

THE CENTER weight of a large Porter governor on a 500-hp. engine was stuck so fast that 2 men could not turn it. The 2 washers, A, A, were stuck together and the center weight was stuck to the top washer, A. I took the bolt out at the top of the flyball arms and let the

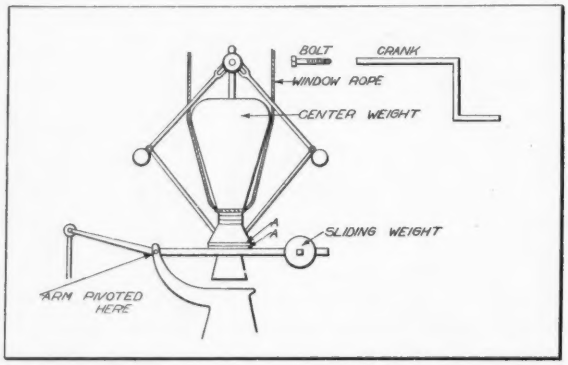


FIG. 1. LIFTING A "STUCK" GOVERNOR WEIGHT

arms hang down. Then I put a crank through the bearing where the bolt was and next, a piece of strong cord around the lower part of the center weight, and put double rope and 2 timber hitches in the cord 180

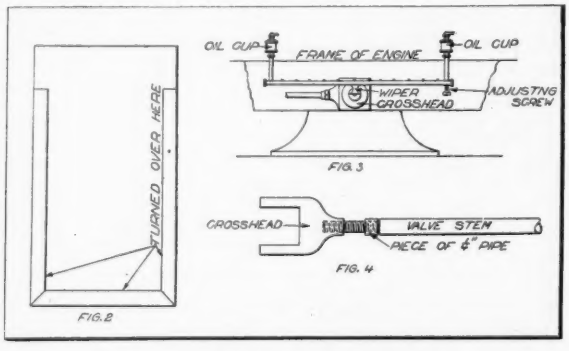


FIG. 2. REFLECTOR FOR GAGE GLASS
FIG. 3. OILER FOR CROSSHEAD
FIG. 4. LENGTHENING VALVE STEM

deg. apart. Then the ends of the rope were wound around the crank. With enough turns of the cord around the crank, there was friction enough to prevent the rope from slipping when the crank was turned to lift the weight.

To make a reflector which helps to show water level, get a piece of pine board as long as the gage glass and wide as desired and tack to it a piece of zinc. Into this a piece of white paper may be slipped, which can be renewed whenever dirty.

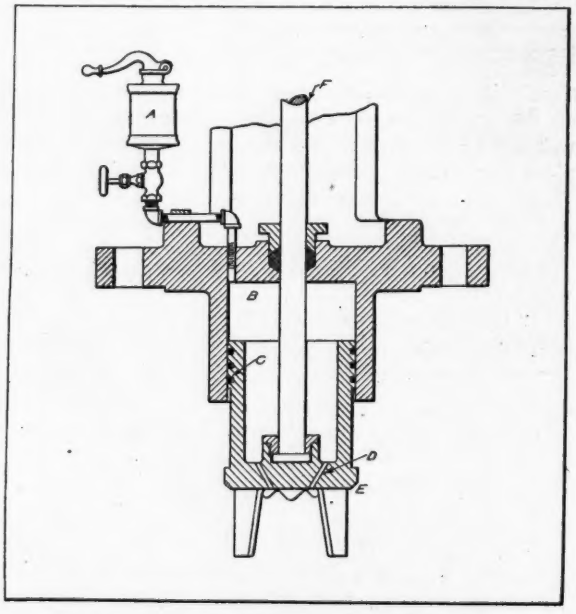
Figure 3 is a scheme to have 2 oil cups feed the crosshead. If one cup should stop, the other would prevent the crosshead from getting hot. This is very good for large, heavy engines. The holes may be either in the top or bottom of the pipe.

I found the valve stem of a duplex pump short so that I had ½ port opening on head end and lapped 3/16 in. on the crank end with pump at mid stroke, rocker arm plumb, and lost motion equalized. This pump was fixed as follows: The valve stem was unscrewed out of the crosshead until the valve was central over the ports and lost motion equalized. Then a piece of ¼-in. pipe just the correct length was put over the threads and stem again screwed into crosshead. Before this change was made they had no end of trouble with this pump. WM. CARRIE.

Trouble with Admission Valve

THE ACCOMPANYING sketch shows the admission valve on a turbine.

The valve E is operated by a piston on the upper end of valve stem F, this piston being in a relay cylinder, and is operated by oil under pressure. The oil is admitted above or below the piston by a pilot valve operated by the governor. The valve E is balanced as shown by small port D, allowing steam chest pressure to enter space B. On one of the turbines under



REMEDY FOR TROUBLE WITH ADMISSION VALVE

the writer's charge, this valve would show a tendency to stick after the turbine had run for about 10 days, and would not open promptly on an increase of load.

As no provision was made to lubricate the piston in chamber B, a small hand oil pump, A, was installed as shown. On starting the machine after the oil pump was installed, it was run for 7 weeks and less than ½ pint of cylinder oil was used; the valve gave no further trouble.

When the oil pump is placed as shown, there is no chance for any oil to get into the turbine, as any excess oil works up around the valve stem F and lubricates the packing in the stuffing box. R. L. MOSSMAN.

Questions Answered and For Answer

Expert Help When In Trouble. If You Want Quick Answer Enclose a Stamp

Some Refrigeration Questions and Anwsers

WHAT IS the loss in ammonia when the liquid is so low in the liquid tank that gas passes to the brine coil without being condensed, and then passes back to the compressor?

2. What is the best temperature for the return of suction gas, when the temperature of the brine tank is 14 deg. F., back pressure 15 lb., and what is the temperature of the discharge when the condensing pressure is 125 lb.?

3. How can you tell when the condenser pressure is right?

4. What is the difficulty when, on starting up in the morning, the condenser pressure is 10 or 15 lb. above normal, and the pump runs faster than usual, this condition lasting for about an hour?

5. With water entering the condenser at 56 deg. F., and the condenser pressure 125 lb., what should be the temperature of water leaving the condenser?

6. When there is no leak in the ammonia system, but the ammonia gradually disappears, what becomes of it?

7. When using about 3 pt. of oil a day, how often should the oil trap be drained?

8. How can you tell when the condenser needs purging?

9. How much ammonia should it take to run a 10-ton plant for a year, making about 1000 lb. of ice a day, for 6 or 7 months in the year, and having cold storage the year around? There are no leaks in the system.

10. What should be the arrangement and connections of the gage glass on the liquid receiver, so that oil can be shown at the same time as the ammonia? Receivers are horizontal.

11. How can leaks in the brine coil be discovered without taking samples of the brine? Also, how can leaks in a double-pipe condenser be detected?

12. What is the weight of a gallon of ammonia?

13. What is the action of ammonia just as it leaves the expansion valve?

14. Is it possible to get ammonia too cold when condensing with water at 56 deg. F.?

15. Our system has "flooded" brine and refrigerating coils. How often should they be pumped down, and to what pressure, when closing down for the night?

16. Can the waste oil be taken from the oil trap and filtered, and then used on some of the machinery elsewhere in the plant? J. C. F.

ANSWERS

THE LOSS is in the refrigerating effect by circulating gas instead of liquid. Liquid takes up heat during vaporization; but, as no vaporization takes place when gas is circulated, there can be no heat absorbed. Refrigeration is rated by the pounds of liquid vaporized while taking up heat and not by the amount of gas circulated. There will also be a greater loss of ammonia due to the decomposition owing to the high temperature of the gas when it is compressed, as the gas will be superheated instead of saturated when it leaves the evaporator.

2. With the brine 14 deg. F. and 15 lb. back pressure, the return gas should have a temperature of about zero, which is the temperature of saturated ammonia vapor at 15 lb. pressure. With this temperature at the return, the whole length of the coil is doing effective work.

The discharge temperature will depend on the type of compressor and the means used for removing the heat of compression. Theoretically the temperature of the discharge at 125 lb. pressure is 74.5 deg. F. In practice, it is higher, often reaching 200 deg. or more when dry gas compressors are used. With humid or wet gas compressors and liquid injection, the temperature can be 74.5 deg. F.

3. The only sure way to know that the condenser pressure is right is to test the gage or use an indicator to check. If the machine is discharging saturated vapor, the pressure and temperature will correspond: 165 lb. pressure will show about 78 deg. F. temperature; 200 lb. about 100 deg. F.

4. The ammonia in the evaporating coils is in a light superheated state, since it has taken the same temperature as the surrounding brine or atmosphere. This gas has to be discharged to the condenser and cooled before normal running conditions are obtained; or, the expansion valves are not opened soon enough after starting the machine and it takes some time to build up the back pressure. This is especially the case with motor-driven machines where full speed is attained at once. With this type, it is often necessary to open the expansion valves a short time before starting up so as to give the machine something to work on.

5. A difference of 10 deg. F. between inlet and outlet water is good practice. With 125 lb. condenser pressure, it is possible to have the outlet water about 74 deg. F. when the inlet is 56 deg. F. This is seldom found in ordinary operation.

6. The ammonia decomposes and noncondensible gases are formed. This is due to oil, moisture or other foreign matter in the system and to excessively high discharge temperature.

7. It will depend on the size and type of oil trap. If the trap is small and there is any danger of the oil being drawn into the system again, the trap must be emptied daily. With the usual sized trap, twice or even

once a week is often enough. Some ammonia is always lost when drawing out oil, so judgment must be used to do the drawing only when necessary.

8. Increased condenser and back pressure, whistling sound at expansion valves, difficulty in holding desired temperatures, frost leaving suction lines and increased discharge temperature.

9. The only loss is in decomposition or wearing out and what is lost when doing repair work, packing the ammonia rods and emptying oil traps. In a carefully operated 10-ton plant where good ammonia and oil are used, not over 100 lb. additional ammonia a year is needed. The amount of the full charge will depend on conditions and is variously estimated at from 25 to 45 lb. per ton refrigerating capacity. A 10-ton combination ice making and cold storage plant will require about 400 lb. when operating under ordinary conditions.

10. The lower connection must be made in the bottom of the receiver so that the bottom of the glass will be in line with the lowest point of the inside of receiver. Such connections are necessary, as oil is heavier than liquid ammonia and will settle to the bottom.

11. Large leaks may be heard or smelled; but to find small leaks, it is necessary to use litmus paper or Nessler's solution when the ammonia is leaking into the brine.

Leaks in the double-pipe condenser can be found by taking samples of water from each stand and testing with litmus paper. The water inlet and outlet valves should first be shut so that the still water may become charged with the leaking ammonia. After the stand is located, the return bends must be removed on one end and the leaky pipe found either by smell or with wet litmus paper or a sulphur stick. Split inner tubes can generally be located by the crackling sound of ammonia going into the water.

12. A gallon of liquid ammonia will weigh differently at different temperatures as the specific gravity decreases with increased temperature.

Temperature	Specific-Gravity	Weight
14 Deg. F.	0.6492 Deg.	5.41 Lb.
32 Deg. F.	0.6364 Deg.	5.3 Lb.
50 Deg. F.	0.6230 Deg.	5.193 Lb.
68 Deg. F.	0.6089 Deg.	5.075 Lb.

13. The pressure is reduced from condenser to back pressure. The liquid at the reduced pressure vaporizes as it takes up heat from the surroundings. From 15 to 20 per cent of the liquid is vaporized by the heat contained in itself. This is necessary before heat can be absorbed from the brine or surrounding atmosphere.

14. No. The colder the liquid, the more effective it is in absorbing heat. In cold weather or with a small charge of ammonia, the liquid may become sluggish in its circulation; but this must be charged to causes other than its being too cold. In practice, under varying outside temperatures, it is sometimes necessary to shut off some of the condensing water to keep the ammonia circulating. This is necessary, as it is not practicable to increase and decrease the charge to suit the changing weather.

15. All ammonia systems should be pumped down to 2 lb. above atmospheric pressure at least once every 24 hr. so as to prevent ammonia from the so-called "hiding out" in the evaporating coils. The reduced pressure will cause any ammonia hiding out to evaporate and circulate.

When shutting down for the night, pump the system down to about 1 lb. gage pressure. Do not pump below atmospheric pressure at any time unless it is absolutely necessary, as there is danger of pulling in air or brine through small leaks.

16. Yes. This oil can be settled and filtered and used again on the ammonia rod or it can be put through the regular engine oil filter. The latter way is the best. Use new oil on the ammonia rod, and what is taken from the trap will make up loss in the engine oil supply.

A. G. Solomon.

Hoisting Engineers' Examination *

11. For an engine such as the McEwen automatic, with the bottom guide milled on the frame, how can the crosshead be raised 1/32 in.?

12. How would you line up a single slide-valve engine by the use of a level, plumb-bob and line? Give the general method of doing this.

13. Give in detail the directions for setting a horizontal return tubular boiler 72 in. in diameter and 18 ft. long, from the time it is taken from the car until steam is up.

Answers

11. The crosshead shoes of the McEwen automatic engine may be adjusted so as to raise or lower the crosshead as desired by means of 4 adjusting screws at the bottom of the crosshead.

12. Assume the engine a comparatively small one of one-piece frame with bored guide; also that the main bearing consists of a top and bottom shell, and quarter boxes, the front one only being adjustable. We will also say that the wheel is of the split-hub type and has been slipped onto the shaft and bolted at the hub bolts.

Check up the foundation bolt holes with the frame and if they are all right, place the frame on the foundation, leveling it up on metal wedges, till it is about 1 in. above the foundation to allow a good bond for the grout. Remove wedges about 3 days after grouting.

Slip the crosshead to the forward end of the slide, or remove it entirely if necessary, and level the frame lengthwise by placing the level in the lower slide. Level crosswise as you proceed, by placing the level in the bottom bearing, or on the top of the frame if it is machined, or use the plumb level on the face of the bearing.

Put the outboard bearing in place and have it as near level with the main bearing as you can get it by means of a straight edge laid across it. Remove the outboard bearing cap.

Lower the shaft into place, using care not to disturb the engine. Remove the piston and stretch a line from the back end of the cylinder through the slide (and the crosshead, if in place) and set it true with the bore of the guide by means of tram sticks.

This line should extend past the crank and be fastened preferably to the frame itself by any means that conditions might suggest. Now you can move the outboard end of the shaft forward or back as required and when the crank is rotated about half a revolution so

*Continued from page 699, July 15 issue.

that the pin will just about touch the line, you can measure from the end of the pin to the line and note whether the distance is the same at both points. When it is, the shaft is square with the center line of the engine. Clamp a small stick at the top of the wheel in such a position that a plumb line dropped from it will miss the shaft (and also the hub, if possible, although the latter is not absolutely necessary). This line should be about 1 in. from the edge of the rim; the closer the better, so it does not touch. Raise or lower the outboard bearing on the wedges till the plumb line is the same distance from the edge of the wheel at the top as it is at the bottom. See that the shaft rests evenly on all bearings and that none of them are twisted. Check over all the work carefully, and if you find it all right, you are ready to grout.

13. For the sake of clearness and preciseness, we will assume certain conditions and make such comments on them for possible change as we go along.

There are 2 principal methods of taking the boiler off the car and you will have to determine which meets local conditions best. Build an inclined skid beside the car, using timbers about 8 by 8 in. or 8 by 10 in. for skids, blocking well with good blocking or railroad ties if convenient. Arrange a landing platform at such a distance from the car that the boiler will eventually land on it right side up, and have this platform about 2 ft. from the ground so that when you come to put the rollers under it, you will not have to raise the boiler any, but rather lower it.

You will also have to determine on the job whether the boiler is "right end to" on the car or if it has to be turned end for end. If it has to be moved some little distance, you can generally arrange to turn the boiler enroute without difficulty. If the distance is short, it will usually be found better to turn the boiler on the car.

Provide 2 hardwood boards (maple is best) say about 8 by 18 in. each and 1 in. or more thick. They should be well dressed on one side and thoroughly greased. Provide another plank or similar material and construction, 12 in. wide by about 18 in. long and should be at least 2 in. thick.

By means of stone jacks, pump jacks, or whatever means are at hand, raise the boiler on the car high enough to lay the 2 boards on the car greased side up, and the plank on top greased side down, and lower the boiler so that it balances on these boards as a pivot. Put chock blocks on each side of the top one so that it will turn with the boiler; the lower one will stay in place on the car, or you might nail it if the car floor is new or too smooth.

With planks or boards, lay a rough track around the car nearly as high as the pivot blocks to prevent the boiler from tipping endwise very much. If you have made a good job of balancing, 2 men on each end can push the boiler around in a few minutes.

Having determined which way the boiler is to enter into place, pass a good line around the boiler, fastening the bottom end to the car opposite the skidway, and throw the top end over the car where it can be snubbed around a tree, telegraph pole, or a "dead man" sunk in the ground for the purpose.

Start the boiler off the car with bars, keeping its progress well in hand with the rope, and as it passes downward on the skids, slack off on the rope till it has landed at the platform.

As a boiler of this size weighs only about 18,000 lb., it can be raised high enough on the car to insert about 3 heavy 8 by 10-in. by 16-ft. timbers. By means of screw jacks, raise the boiler enough to clear the car, setting the jacks on blocking placed alongside. When high enough, run the car out from under, and lower the boiler as desired till low enough to insert the skids and rollers.

Make 3 or 4 strong cradles out of 8 by 8-in. or 8 by 10-in. and 66 in. long, sawing or chopping them out slightly in the middle to conform to the radius of the boiler. Place these under the boiler; and under the outer end place skids, which should be preferably 8 by 8 in. by 16 ft. chamfered slightly so as to take the rollers.

As to rollers, wooden ones, 6, 5, or even 4 in., are better than pipe, but if not at hand, pipe rollers not less than 3 in. can be used. Use plenty of them and see that they do not "skew" so as to bind.

Build a good track the same gage as the width of the skids under the boiler, and if necessary to use a grade, make it gradual and even throughout. As a motive power, a capstan can be used with one horse or a winch and 2 men, or a block and tackle and several men or a horse, whichever means is most convenient. At any rate, progress must be reasonably slow but steady, and have men enough to keep the rollers coming to the front and 2 good men on either side to cut the rollers as necessary.

Run the boiler onto the foundation which we assume has been built.

Usually the flush front is set about 4 in. back of the foundation wall in front, which will give ample room for the brickwork. The width of the dead plate and fire door liners will give you a cue to this. Measure the throat of the flush front and jack the boiler up about 1 in. higher than this above the foundation, giving room to level the front and grout under it. Put up the steel framework, bolting it well together, and plumb the posts and level across the top piece, wedging if necessary, under the posts, and brace well either to adjacent walls, or to posts well driven into the ground. Put in the support rods which support the boiler from the top, and draw up on these till the boiler is level crosswise, and about 1 in. lower at the back end than at the front, and at the same time is the right height to receive the front. This process will usually raise the boiler clear from the track and rollers, which can then be removed.

If the boiler is to be supported on the brick walls by lugs, you will have to raise and level the boiler by means of jacks on blocking under the boiler, arranging it so that one set of blocking will be in the ash pit and the other in the combustion chamber, clear of all walls or dead plates that will have to be built in. When you have the boiler on jacks and in position, block up to the boiler as a matter of precaution. When you get this far, the skids have been removed and you have as clear a space as possible for the masons.

While the masons are getting ready and starting on the brickwork, the steam fitters can proceed to put up

the water column and the blowoff pipe. Use nothing but extra-heavy pipe and fittings for this. See that all threads in the boiler are tapped enough to get a good full thread on the pipe. If convenient to get them, use steel hydraulic fittings which are tested to 1060 lb. pressure. They are best in the long run. Use crosses on the water connections of the water column and brass plugs where necessary to plug, as they are more easily removed for cleaning than iron ones.

The water column should be set at such a height that the bottom of the water glass will be about 4 in. above the top of the tubes in a boiler of this size. Build in a piece of pipe in the ashpit wall through which you can run the water column drain pipe.

On the boiler blowoff, run the pipe down well toward the bottom of the combustion chamber and put on a hydraulic elbow, preferably one of the long sweep variety. Then extend the pipe through the rear wall or one of the side walls as circumstances demand, and put on double valves, having the one next the boiler preferably a straightway gate valve, made for this purpose. The outer one may be an angle blowoff valve with some kind of renewable seat and valve. In this way, you can always have a tight blowoff. From the second valve, run the pipe either to the atmosphere if it will not interfere with anything, or to a blowoff tank suitably located.

Look the boiler over well inside and out. Strange things have been left inside of a boiler, such as overalls, wrenches, slugs, rivets, bars, and even torches and shoes, to say nothing of the accumulation of chips and debris which will soon clog the blowoff pipe or injure the valves.

If a plain grate is used, this should be set so as to be about 3 in. lower at the bridge wall than at the door, as this permits better combustion, firing, handling of the slashbar, hoe, etc. Allow for about ½ in. expansion in the grate bars; that is, place the dead plates ½ in. farther apart than the total length of the bars.

Do not use poor brick, for they are an expensive investment. It is customary to lay one course of firebrick, edgewise to the fire, the same as brick are ordinarily laid. Sometimes 2 courses of firebrick are laid in this manner, making practically 8 in. of firebrick lining.

A single course of brick is not to be recommended if the boiler is to be worked above ¾ of its capacity at any time. Two courses as described above are, of course, better than one; but as soon as the outer course burns through, or nearly so, the brick above will begin to fall away, and probably endanger the setting.

The best method of lining a firebox is to lay the brick in headers, that is, ends to the fire, and breaking joints as usual. You thus secure 8 in. of brick, and when these burn through near the fire, those above are still in place and will outwear 2 or possibly 3 sets, right at the fire where the excessive heat and the firing tools hasten deterioration.

The lower buck stay rods must be placed in the foundations as you start, and if they pass entirely through the setting, it will be to advantage to slip a piece of 1-in. pipe over the rod before bricking it in. Water used to cool the ashes and to settle the dust in the combustion chambers eventually reaches the rod, and it will soon corrode. A pipe will lengthen the life of the rod and the cost is little.

Set up the flush front about 1 in. above the foundation and level it on wedges at the right height. Grout under it with cement mortar (not lime mortar) and as the brick work progresses, insert the tie rods, door frames in combustion chamber, etc., and ash pit and firing doors.

The blueprints will show the design of the bridgewall; but if no prints are supplied, let the bridgewall be constructed in headers set on edge, about 8 in. high, square with the grate surface. From this point, slope back at about 45 deg., till the wall is about 16 in. from the boiler shell and straight on top. The header brick in the bridgewall resist the action of the heat and the firing tools better than any other construction. The sloping portion of the wall should be laid with firebrick on edge, but it is not necessary to break joints. Back of the bridgewall, it will not be necessary to lay the brick in headers, as a single course of firebrick laid in the ordinary manner will, in this inexposed position, last as long as several linings of the firebox.

To protect the blowoff pipe leading directly from the boiler, construct a V shaped guard of firebrick, with the apex of the angle towards the firebox. Run the brick up against the boiler snugly so that there will not be a small hole through which the hot gases can continuously impinge on a small portion of the pipe or shell.

The arch over the rear of the boiler should be circular in shape in preference to a square corner effect, as it promotes rapid circulation of the gases. It is best not to cover the top of the boiler until the boiler has been under steam a few days, for there may be a few leaks around rivets that require attention and which might cause a prolonged leak and cutting if concealed.

As soon as the boiler has been permanently located, take measurements for the main steam piping so as to have it cut and bent as soon as possible. Screwed pipe and fittings on medium and large work are being displaced by bent pipe with one of the several good types of flanged or welded flange connections.

Main piping should be double valved, placing valves at the highest points, and draining if necessary. A gate valve is preferable to a globe valve, although an angle valve can sometimes be used to good advantage as a main valve on top of a boiler.

The safety valve can be put on at any time. The steam gage can be piped either to the top of the water column, or to the top of the boiler direct as desired.

Feed water is sometimes introduced into the boiler through the front head and sometimes through the top, and in either case, the piping is continued inside the boiler towards the rear and then halfway across where it turns down through the opening between the 2 center rows of tubes. This piping should be fastened permanently to prevent wear from vibration.

The injector is usually connected direct to its own boiler, while the feed pump can be connected to the main steam pipe; although, in a battery, it is preferable to have a separate small main for the auxiliaries.

When the wall has "set," remove the blocking through the firedoors and finish the interior. It is best to slope the combustion chamber to the rear from the top of the bridgewall to the bottom of the cleanout door in the rear. The ashpit should be cleaned out on a slope so as to be about 6 in. lower at the back than the floor and lined with cement over either concrete or brick.

Put in the grate bars, or if a shaking grate is used, install it as indicated in the blueprints furnished. The general scheme of a shaking grate should be looked over before starting the brickwork, as it may be necessary to cut holes in the cast-iron front and also in the brick work for the shaking rods or levers.

The stack is the next proposition, although this can be started as soon as the boiler is placed. If the stack is raised directly from the boiler it is generally done by someone with the necessary tackle and winches to handle the work. If the gases are to be conducted from the boiler to a stack some distance away, take the measurement as soon as the boiler is in place and have the breeching made by some manufacturer and shipped as soon as possible.

With the stack connections on and the piping in place, fill the boiler with water up to near the top, leaving the top manhole plate out. Start a slow fire of light wood, leaving the damper open just enough to carry the smoke away. Let this smolder for a few days and gradually increase the fire till, in a week, you can use a small coal fire. At any time previous to this, put the buck stays on and screw up the bolts snugly.

Bring the water to a boil for a day or so, and after the fire dies, empty the boiler, which will wash out all grease, etc. Fill up again with fresh water, put in the top manhole cover and gradually raise steam; as soon as the gage begins to register, increase the pressure gradually, and as you proceed, take up on flanges, etc., all round, and note whether any rivets leak.

When satisfied that the boiler is tight, raise the pressure till the safety valve blows and note whether it blows at the corresponding pressure called for and indicated by the gage. If in error, find out which is wrong and remedy, then you are ready to place the boiler in daily operation and can cover the top with brick or asbestos.

Temperature of Steam Varies with Pressure

IF YOU have 2 pieces of pipe of equal length and diameter, one containing steam at 2 lb. pressure, and the other at 10 lb. pressure, is there any difference in the amount of heat given off by these 2 pipes? J. L. M.

A. The amount of heat given off by the pipes depends on the difference in temperature between the steam inside and the air outside, therefore the higher the temperature of the steam inside, the greater will be the number of heat units given off.

The higher pressure steam has, of course, a higher temperature. Steam at 10 lb. gage would have a temperature of 239 deg. F., and at 2 lb. gage, 218 deg. F. If the temperature of the room is 68 deg., the heat given off will be in proportion to 239 — 68, and 218 — 68, or as 171 to 150. A. L. R.

Horsepower Constant

WHEN IS the slide valve termed a balancing valve?

2. What is the horsepower constant of a 12 by 14-in. engine running at 200 r.p.m.? D. E. C.

A. Slide valves are balanced in several ways, some manufacturers use plates, others have a telescope arrangement, but the whole principle is to prevent steam pressure from acting down upon the valve, forcing it against the seat and when this is accomplished, the valve is called "balanced."

2. The horsepower constant for an engine with varying speed equals the product of its length and stroke times the area of its piston divided by 33,000. If, however, the speed of your engine does not vary, you may include the speed, which in your case would be the product of 1.1667 times 113.098 times 400 divided by 33,000, or 1.5996, as the horsepower constant. This constant multiplied by the mean effective pressure will give the indicated horsepower. If you do not include the speed in your constant, you must multiply the constant by twice the revolutions per minute and the mean effective pressure. G. A. T.

Examination Questions

WHAT IS a vacuum breaker?

2. In figuring the heating surface of a boiler do you take into account the area of both or only one head? Do you use ⅔ or ½ the area of the shell?

3. Explain why inches of mercury are connected to vacuum. G. H. S.

A. A vacuum breaker is a device installed on a condenser, usually of jet or barometric type, which will open a valve to the atmosphere when for any reason the condenser becomes flooded. This is usually some type of a float valve, which is held closed so long as there is vacuum on the system, but if the water rises in the condenser, the float forces the valve open and permits atmospheric pressure to enter, thus throwing the exhaust from the engine to atmosphere. In this way, water is not drawn up from the condenser to the point where it can work back into the exhaust pipe from the engine and cause trouble at the cylinder.

2. In figuring the heating surface of a boiler, some authorities take ⅔ of the shell, and some take ½. It is a matter of preference, and depends on the way the boiler is set. If the brickwork is drawn in close at about ½ the height of the shell, as shown in Fig. 4, section through AA^1, on page 11 of Jan. 1 issue, then ½ the shell would be used. If, on the other hand, the closing in of brickwork takes place at considerable above the center, as indicated in the general view of cross section, on page 8 of the Jan. 1 issue, then ⅔ of the shell would be more nearly correct.

3. In the early days of the condensing engine, it was almost impossible to get vacuum gages of the spring tube type which were accurate and sensitive. For this reason, the mercury U-tube was chosen for such measurements, and people became used to estimating the vacuum in a condenser or an engine cylinder, in the number of inches, difference of level of the mercury in the 2 branches of the U-tube. This U-tube gage is still used largely in vacuum work, and because so many engineers are accustomed to figuring in this way, many spring gages are still graduated in inches of mercury, although most of these carry a double graduation, showing the pounds of vacuum as well as the inches of vacuum. In a way, it is easier to think of the pressure as inches of vacuum rather than as pounds absolute. For engines, 26 in. of vacuum corresponds to 1.961 lb. absolute pressure; 28 in. corresponds to 0.981 lb.; 29 in., to 0.491 lb. It is easier, therefore, to talk of 26 in., or 28½ in., or 27¼ in. than it is to speak of the absolute pressure. A. L. R.

PRACTICAL
ENGINEER
Trade-mark reg. U. S. Pat Office.

PUBLISHED THE FIRST AND FIFTEENTH OF EACH MONTH
BY THE TECHNICAL PUBLISHING CO.
537 South Dearborn Street,
CHICAGO, ILL.

New York Office, 150 Nassau St.

Notify us at once of any change of address, giving the old and the new address, so that your paper may always reach you promptly.

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Entered as second class matter May 1, 1908, at the Post Office at Chicago, Illinois, under the Act of March 3, 1879.

Circulation of this issue, 22,500.

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Why Study Mechanical Refrigeration?

One of the largest manufacturers in Pennsylvania is reported to have prophesied that within 25 yr. ice would be practically abandoned as a means of refrigeration. While the actual accomplishment of such a radical change may be doubted, there is much evidence to support such a contention. At present, about 2000 butcher shops and meat handling stores have abandoned the use of ice and installed refrigerating machinery instead. At least 1000 creameries and over 500 ice cream factories have done likewise. More than 1000 hotels and restaurants have installed refrigerating machinery for cooling their provision boxes, and to manufacture what little ice they use for the table, freezing the carafes in the chillroom and letting them thaw out on the tables.

And when, in addition, the great number of produce dealers, fruit men, general stores, grocers, etc., who have installed or plan to install refrigerating machines is considered, and furthermore that a score or more of companies are manufacturing or are about to introduce small refrigerating machines for household use and for use in small shops and stores to replace the old familiar ice box, the reason for the prophesy becomes apparent.

Refrigerating machines are installed because, under most conditions, they are more economical than ice. But that is not the only advantage. The pure food law agitation has opened the eyes of the people to the injurious effects of moisture in connection with the preservation of perishable food products. Where ice is used, moisture and its attendant dirt and favorable breeding-ground for bacteria can not well be avoided. It is true that some have used calcium chloride in order to absorb excess moisture, but it does so only by itself becoming a liquid, and thus slop and slime still exist.

When no ice is used and temperatures are regulated by means of the refrigerating machine, greater cleanliness becomes easy and always results. Besides, lower temperatures are carried than when ice was used, and in consequence the foods come out much better in appearance, which promotes trade. So that, when all the advantages are considered ice becomes undesirable as a refrigerating medium, at least wherever business is conducted on an extensive scale.

The cooling of halls and buildings by means of the refrigerating machine is advancing, and plans are now under way to install air cooling and air conditioning plants for both House and Senate chambers at Washington.

Thus it will be seen that the use of mechanical refrigeration, already large, is rapidly extending, and the duty of operating refrigerating machinery and apparatus is being thrust upon the operating engineer in greater and greater degree every year.

It, therefore, becomes incumbent upon him to know the principles that underlie the process of mechanical refrigeration, and to acquaint himself with its practice as thoroughly as circumstances will permit. Courses in technical schools are not yet adequate, and what one picks up from contact with other engineers is usually insufficient, because some of the basic factors, taken for granted by the competent man, are not to be learned in operation; hence, the engineer must have recourse to books and periodicals and to individual study.

News Notes

THE JURY OF AWARDS at the Panama-Pacific International Exposition has awarded The Bristol Co., of Waterbury, Conn., the Grand Prize for Recording Instruments.

W. P. COCHRAN, formerly branch manager of the Westinghouse Electric & Mfg. Co. at Baltimore, has been appointed Assistant District Manager of the Philadelphia district, including Baltimore, and will make his headquarters in the former city. M. H. Jones, Assistant to Manager, will have charge of the Baltimore branch office.

U. S. CIVIL SERVICE COMMISSION announces the postponement from June 23 and 24, to Aug. 18 and 19, 1915, of the open competitive examination for marine engine draftsman for submarines, to fill a vacancy in the office of the Inspector of Machinery, Electric Boat Co., Groton, Conn., at a salary of $5.04 a day, and vacancies as they may occur in positions requiring similar qualifications at entrance salaries ranging from $4 to $5.04 a day. Age, 22 yr. or over. Competitors must submit to the examiner on the day of the examination their photographs, taken within 2 yr. Apply for Form 1312, stating the title, Marine Engine Draftsman for Submarines (Male), to the U. S. Civil Service Commission, Washington, D. C.

U. S. CIVIL SERVICE COMMISSION announces an examination for marine engine and boiler draftsman, on Aug. 18 and 19, 1915, to fill a vacancy in the Industrial Department of the United States Navy Yard, Portsmouth, N. H., at $3.52 a day, and vacancies as they may occur in any U. S. navy yard or naval establishment or in the Department at Washington, D. C., at entrance salaries ranging from $3.52 to $5.52 a day.

In filling vacancies in navy yards and other naval establishments certification will be made of the highest eligibles examined in the vicinity of the place at which the vacancy occurs, except that upon the request of the Navy Department certification will be made of the highest eligibles on the register for the entire country who have expressed willingness to accept appointment where the vacancy exists. Applicants must have had a technical school education suitable for the position or 4 yr. suitable practicable experience, of which at least 1 yr. must have been in office drafting. Age, 18 yr. or over. Applicants must submit to the examiner their photographs, taken within 2 yr. Apply for Form 1312, stating the title, Marine Engine and Boiler Draftsman (Male), to the U. S. Civil Service Commission, Washington, D. C.

U. S. CIVIL SERVICE COMMISSION announces open competitive examinations for junior engineer (civil) and junior engineer (mechanical or electrical), for men only, on Aug. 25 and 26, 1915. Requirements are 4 yr. good civil (or mechanical or electrical) engineering experience, or graduation in civil (or mechanical or electrical) engineering from an approved technical school. From the registers of eligibles resulting from these examinations selections may be made to fill vacancies arising in the grade of junior engineer in the Engineer Department at Large. The examinations are, however, held primarily to enable applicants to qualify for the examination to be held by the War Department on or about Oct. 25, 1915, for commissions as second lieutenants in the Corps of Engineers, U. S. Army. Of those who attain eligibility in one of these examinations only those who meet the following conditions will be permitted to take the examination given by the War Department: They must be (a) unmarried, (b) between 21 and 29 yr. of age, and (c) graduates in an engineering course from an approved technical school. These examinations will not include anything that is not covered by the respective courses in engineering given by reputable technical schools. Persons who desire these examinations should at once apply for Form 1312, stating the title of the examination for which the form is desired, to the U. S. Civil Service Commission. Information regarding examination given by the War Department and application blanks will be furnished to persons qualified on application to the Adjutant General, War Department, Washington, D. C.

U. S. CIVIL SERVICE COMMISSION announces examinations for senior drainage engineer and drainage engineer to fill vacancies in these positions in the Office of Public Roads and Rural Engineering, Department of Agriculture, for service in the field, at salaries ranging from $2220 to $3000 and from $1800 to $2100 a year, duties to consist of making surveys, preparing plans and reports upon drainage projects, collecting technical data, and conducting original investigations.

Applicants for the position of senior drainage engineer must show that they are graduates in civil engineering from technical schools or colleges of recognized standing, and that they have had at least 5 yr. experience in drainage engineering work as applied to agricultural lands, both technical and practical, subsequent to graduation; or, if not graduates, that they have had not less than 9 yr. civil engineering experience, of which at least 5 yr. shall have been in drainage engineering work as applied to agricultural lands, or that they have had any combination of such technical training and experience aggregating 9 yr.

Applicants for the position of drainage engineer must show that they are graduates in civil engineering from technical schools or colleges of recognized standing, and that they have had at least 3 yr. experience in drainage engineering work as applied to agricultural lands, both technical and practical, subsequent to graduation; or, if not graduates, that they have had not less than 7 yr. civil engineering experience, of which at least 3 yr. shall have been in drainage engineering work as applied to the drainage of agricultural lands, or that they have had any combination of such training and experience aggregating 7 yr.

For the position of senior drainage engineer, applicants must have not reached their fiftieth birthday on the date of the examination; for the position of drainage engineer, their forty-fifth birthday. Separate registers will be established for work on irrigated lands and on humid lands. Applicants should state in their applications for which register or registers they desire to be examined. Apply for Form 304 and special form, stating the title, Senior Drainage Engineer (Male), or Drainage Engineer (Male), to the U. S. Civil Service Commission, Washington, D. C.

Power Apparatus in Shop and Market

New Ideas In Making, Buying and Selling

Busch-Sulzer-Diesel Engine Day

ONE exhibit that has attracted unusual favorable attention at the San Francisco Exposition is that of the Busch-Sulzer-Diesel Engine Co. On a Monday which was celebrated Busch-Sulzer Engine Day a reception was attended by over 500 invited guests. Lieut. G. W. Danforth, Chief of the Department of Machinery, presiding and introducing the speakers:

Charles V. Vogelsang, representing President Moore of the Exposition, presented Manager W. S. Higer with a bronze medal of honor commemorating the splendid exhibit, its prompt preparation and efficient management. Lieut. Commander Woodward of the U. S. Navy explained the use of the Diesel engine in the Navy and

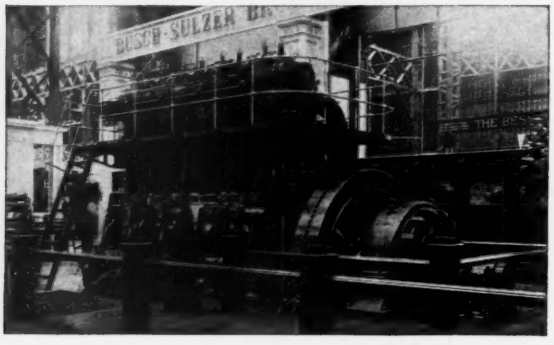


EXHIBIT OF THE BUSCH-SULZER-DIESEL ENGINE CO. AT THE PANAMA-PACIFIC EXPOSITION

Guy C. Bayley, Chief Electrical and Mechanical Engineer of the Exposition, explained in non-technical language the theory of the engine.

It may seem strange that the progress of this engine has been so apparently slow in this country as against the rapid strides made in Europe. Dr. Diesel answered this question in an address made before the American Society of Mechanical Engineers as follows:

First: Coal and oil are much cheaper here than in Europe and therefore are much more wastefully used.

Second: Steam engines are much cheaper in this country and therefore the carefully constructed Diesel is more expensive than the ordinary type of steam engine.

Third: General business profits have been so large in this country that it has not been necessary to investigate each and every expense and it is only in the last few years that concerns have realized the need of great economy.

The Diesel engine is manufactured in sizes from 120 to 4000 hp. and can use economically any kind of liquid fuel. It is remarkable to note that the total expense of operating this engine of 500 hp. for one hour is less than 68 cents for fuel and lubricating oil.

Development of the marine engine is being taken up and in a short time will be placed upon the market an economical and perfectly operating marine Diesel engine. Also a Diesel engine-driven locomotive has been developed which Sulzer Bros., together with the late Dr. Diesel, placed in operation upon a Prussian State Railroad. This engine has been operating satisfactorily and it is only a question of time when it will open up a field for Diesel engines of far-reaching magnitude.

This exhibit is located in Machinery Palace, the engine being rated at 500 hp. and direct connected to a 250-volt 325-kw. commutating-pole generator for direct current, built by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., from which current is supplied to other exhibitors using this form of energy.

Electrostatic Potential and Synchronism Indicators

ELECTROSTATIC vacuum glowers are now being used to indicate the presence of potential on high-voltage alternating-current circuits, and to determine when such circuits are in synchronism and may be thrown together.

For indicating potential, 2 appliances, one of which is shown in Fig. 1, have been developed by the General Electric Co. The one illustrated consists of an electrostatic glower, a metallic condenser hood, a switch for cutting the glower in and out of circuit, and a hook for

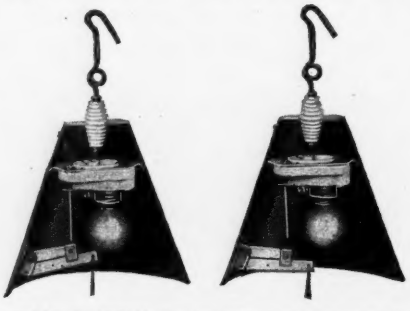


FIG. 1. CROSS SECTION OF VACUUM LAMP TYPE ELECTROSTATIC POTENTIAL INDICATOR, SUSPENSION DESIGN

suspending the indicator from the line and leading current to the glower. One terminal of the glower is connected to a spark gap and then to the lower end of the suspension hook; the other terminal, to the condenser

hood. The loop in the suspension hook enables the indicator to be hung over the line by means of the ordinary type of switch hook used for operating disconnecting lever switches.

The indicator switch, when closed, provides a low resistance path between the line and the hood, and cuts the glower out of circuit. When the switch is open, the glower is connected between the line and hood through the spark gap, and will light up if there is potential on the line at least equal to the tension between the line and ground on a 3-phase system carrying 15,000 v. This indicator is used for indoor and outdoor service, and, as a rule, hangs on the line continually; but, of course, it can be moved about as desired. Usually a grounded wire is connected to the switch string sufficiently close to the hood to be out of reach of the operator.

The second form of indicator is essentially the same as just described, except that no switch is provided and the hood is attached to a long wood rod equipped with a ground cone for connecting a wire between the rod and ground. The upper terminus of the lead running down to the spark gap inside the hood is connected to another lead going to the top of the pole to a metal pin, which is held against the line to determine whether the line is alive. This indicator is, because of its easy portability, most suitable when the indication of potential may be desired on a number of lines.

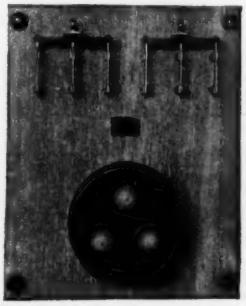


FIG. 2. ELECTROSTATIC SYNCHRONIZER OF THE GLOW POTENTIAL INDICATOR TYPE

In using an electrostatic indicator, one should always bear in mind the fact that, although the lighting of the glower gives a positive assurance of voltage on the line, the lack of glow does not by any means prove the line to be dead, because the bulb may be broken, the leads disengaged, the potential too low, etc.

The usual method of indicating when alternating-current lines or machines may be thrown together, is by the use of a synchronism indicator and synchronizing lamps, or by either the indicator or lamps separately, employing also, as a rule, the potential transformers that are used in conjunction with the meters or instruments. This arrangement is entirely satisfactory; but when it is desired to connect the system together where transformers are not needed for indicating or measuring purposes, the equipment is comparatively expensive. The higher the voltage, the more does this apply.

The electrostatic synchronizer, shown in Fig. 2, requires for operation, however, only the charging current of the line. It consists of a few simple and inexpensive parts, and can be used to considerable advantage in main stations where current is metered on the low side, in switching stations, line junction stations and some substations.

Three electrostatic glowers, mounted in a case, which resembles that used for a round pattern switchboard instrument, are used for each synchronizer. The glowers are connected to the line through condensers consisting of suspension insulators, the insulating value of which is at least equal to that used for insulating the line.

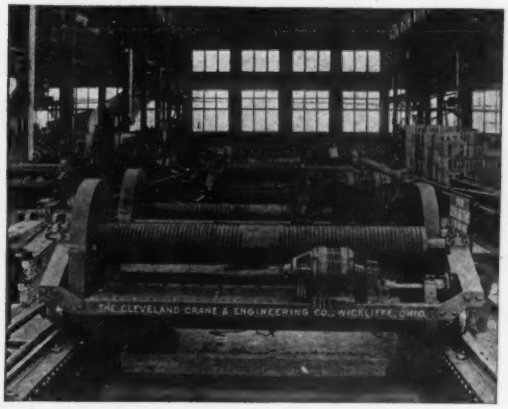
To use the synchronizer, the terminals of one of the glowers are connected through the insulators to the leads of the same phase of running and incoming lines. The other glowers are each connected across dissimilar phases of the remaining leads of the running and incoming lines.

When the lines are not in synchronism, the glowers will indicate the relative frequency of the lines in the same manner as the usual synchronizing lamps. When in synchronism, the rotating effect will disappear, the glower connected to the corresponding lines will be dark and the other 2 will show about ½ brilliancy. The minimum voltage for operation is 13,200, and the maximum depends only on the use of the proper number of insulators.

The synchronism indicator can be used as a ground detector by connecting one terminal of each glower to ground and the other terminals to the line. A lighted glower will indicate that the line is at potential above ground; i.e., not grounded.

Cranes in Ford Company Shops

AN unusual arrangement for the use of electric cranes has been made in the assembling shops of the Ford Co. in Cleveland, Cincinnati, Pittsburgh, Atlanta and Long Island. The cost of handling material is always one of the points which works managements are striving to lower and the plan adopted by the Ford



ELECTRICALLY DRIVEN CRANE AS USED IN FORD SHOP

Co. affords good opportunities for efficiency. The cranes which will be used are shown as they were set up on the assembling floors before shipment. They will be used for unloading material received in bulk from freight cars located on the ground level and for conveying them to the numerous floors in the building.

Load platforms are placed on each floor in staggered location and below the crane runway, permitting material to be loaded or unloaded at any floor.

The cranes have a capacity of 50 tons on the main hoist and 5 tons on their auxiliary hoist with a total possible lift of over 86 ft.

The main hoist has 4 ropes winding onto the drums 8 ft. apart and prevent twisting of the ropes.

The main hoist will be operated by a 40-hp. type CI alternating-current induction motor which is a new Westinghouse motor especially designed for cranes and hoist service. The bridge and trolley motors will be of the same type, of 11 and 5 hp. respectively.

The cranes were made by the Cleveland Crane and Engineering Co., Wickliffe, Ohio.

Andrew Allan, Sr.

MR. ALLAN was born in Edinburgh, Scotland, March 10, 1837, and served his apprenticeship in the brass foundry and finishing shops at the Laidlaw Works, Edinburgh. In 1857 he came to the United States, securing employment as brass molder in the Mitchell Vance Chandelier Works and Henry R. Worthington Hydraulic Works, and in 1865 was placed in charge of H. F. Johnston's Brass Works, in New York City, where he remained until 1891, when the firm retired from business. Following this, he founded the firm of A. Allan & Son, to manufacture the Allan metal brand of bearing alloys.

In 1876 he had invented the process of alloying lead and copper in any desired proportion, with or without tin, and was the first to place such alloys on the market. He was able to use, therefore, a high percentage of lead in a copper brass alloy, and thus secure great advantage for bearing work.

He was an expert swimmer, and even at his advanced age, could hold his own with many younger men. He was apparently in good health, and on July 6 went into the surf for his first swim of the season, and after remaining in about 20 minutes, he returned to his bath house, and while dressing passed away.

Mr. Allan has been out of active business since 1909, but has served in an advisory capacity to the firm which he founded. He is survived by a wife, 3 sons and 2 daughters.

Book Reviews

GRINDING MACHINERY, by James J. Guest; 444 pages, illustrated, 1915. Price $4.20, New York.

Grinding as employed in engineering machine shops is treated fully in this book, which was written to aid engineers, works managers and machine operators to understand how various tasks can be performed, the degree of accuracy which can be obtained, machinery employed and other details in regard to the art of grinding. The whole subject is treated systematically, starting with a chapter on grinding and manufacturing, in which the terms grinding, polishing and lapping are defined and the physical necessity for accuracy in modern manufacturing pointed out. The next chapter deals with the abrasives and the wheel and treats the subject in complete details. Other chapters are the wheel and the work, the work and the machine, details of parts, plain grinders and external work, internal grinders and their work, the universal grinder and its work, surface grinding, sharpening cutters and tools, form grinding and curved surfaces, polishing and lapping, and measuring and its basis. In the appendix are given a number of tables and notes which apply directly to the work of grinding. Throughout the entire book the subjects are treated in a masterly way and will prove interesting and profitable reading to those who have this class of work to do.

PRACTICAL APPLIED MATHEMATICS, by J. W. L. Hale; New York, 1915; 207 pages, 184 illustrations; first edition. Price, $1.

While primarily prepared as a text book for railroad shop apprentice schools, this little volume may advantageously be used in the schools of the mechanical trades generally.

The particular value of this book lies in the practical application of the problems given, which in each case are of some mechanical or electrical nature so that the student will be taught not only the theory but also its value in connection with his daily work. From the rudimentary simple process of addition, subtraction, division and multiplication, decimals, percentage and mensuration, the student is given a general insight into the more advanced mathematics, such as algebra, graphs, etc.

While the so-called "rule" method is to some extent employed, full explanation is in each instance given so that the rule acts more as an aid to the student than a detriment, as is found so frequently to be the case.

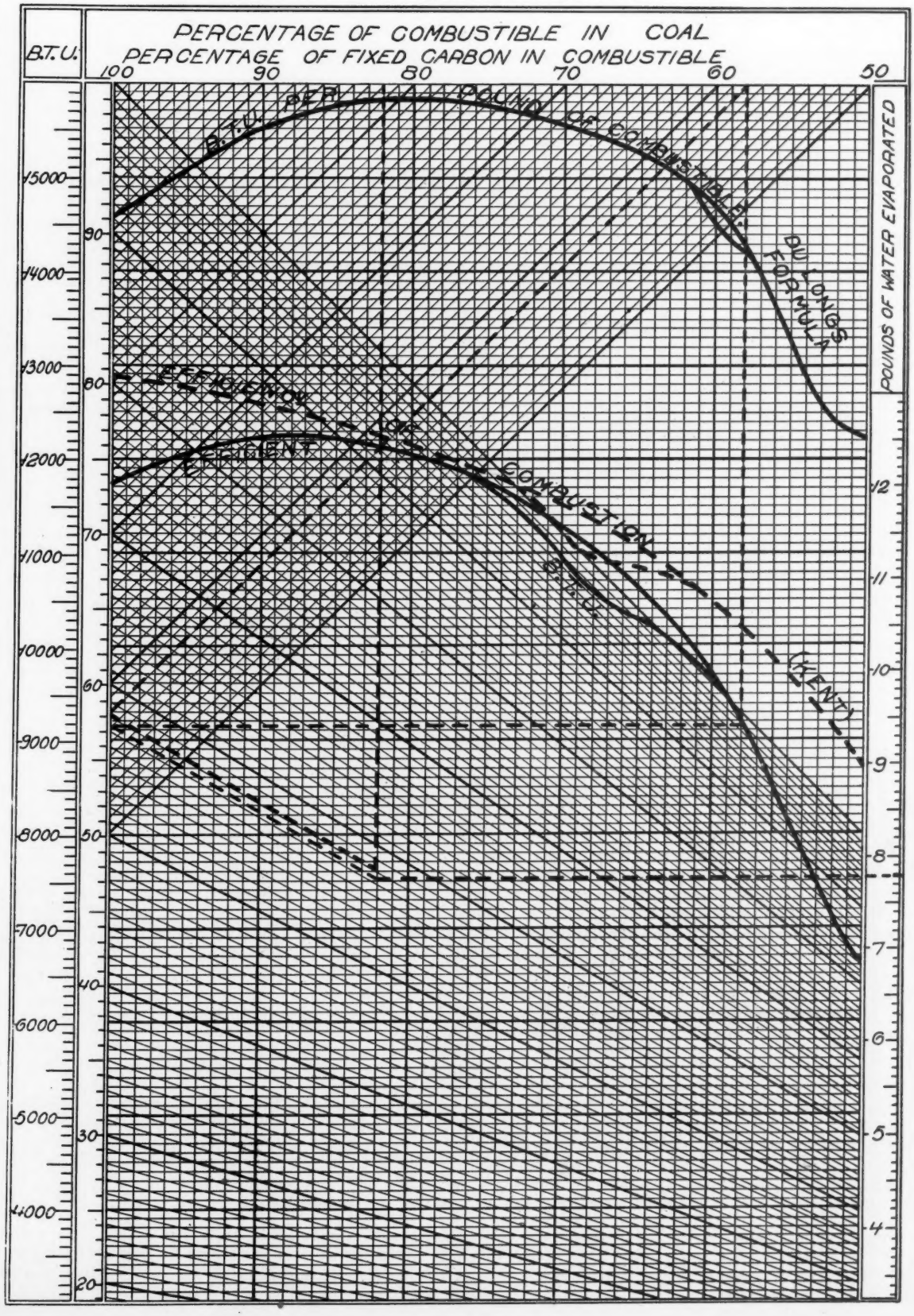
WIND STRESSES IN THE STEEL FRAMES OF OFFICE BUILDINGS, by W. M. Wilson and G. A. Maney, has just been issued as Bulletin No. 80 of the Engineering Experiment Station of the University of Illinois.

In designing an office building it is necessary to determine the stresses in the steel frame due to the wind pressure on the side of the building. There are a num-

These tables contain data especially worked out or carefully selected that are vital to your work. preserve them. A handy, serviceable, loose-leaf

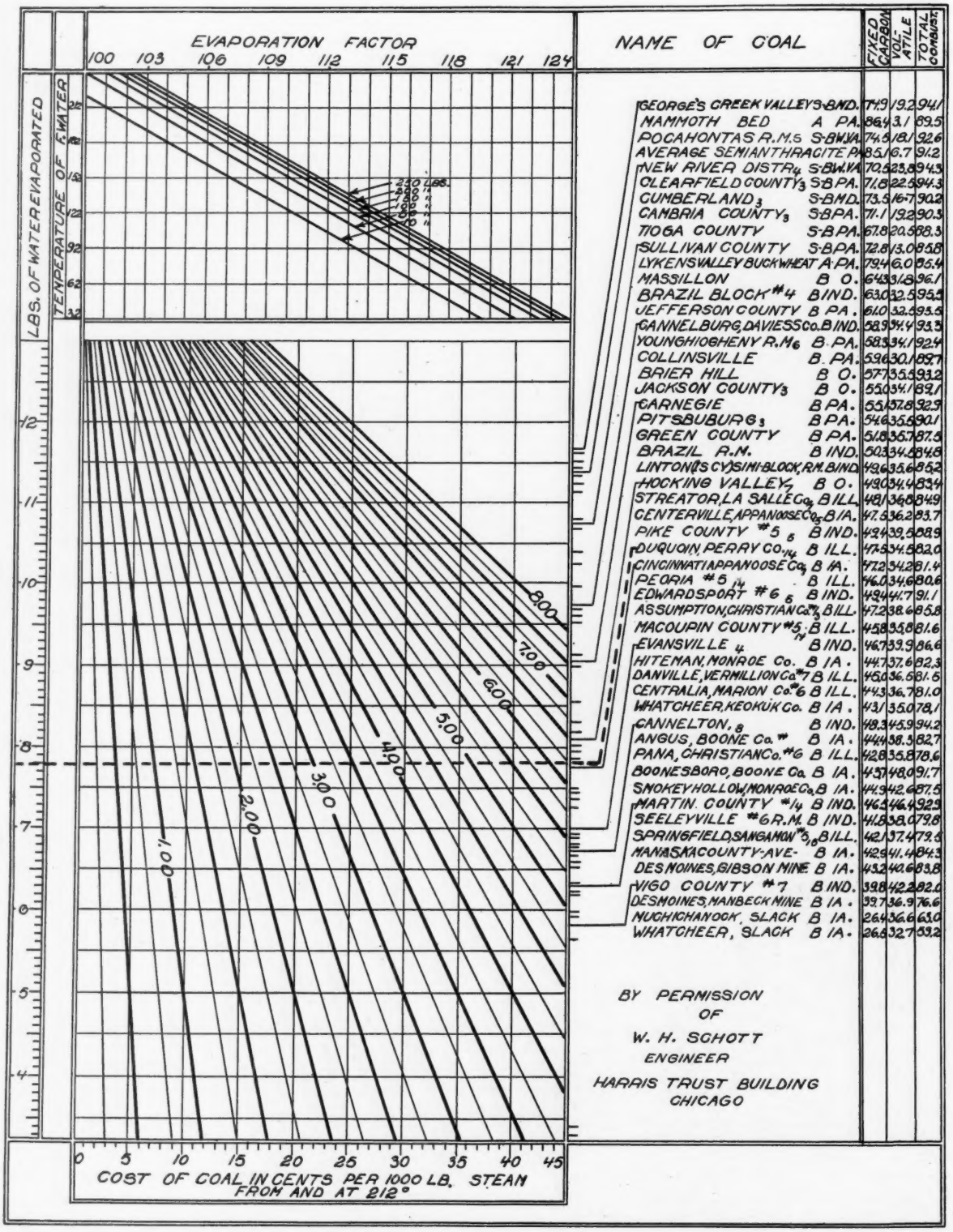
PRACTICAL ENGINEER

CHART I. FOR FINDING THERMAL VALUE AND EVAPORATION FROM AND AT 212 DEG. PER POUND OF COAL



These tables contain data especially worked out or carefully selected that are vital to your work. You may need them at any time and should preserve them. A handy, serviceable, loose-leaf cover in which these tables fit exactly, will be sent you for 30 cents in currency or stamps.

CHART II. FOR FINDING EVAPORATION AND COST PER 1000 LB. OF STEAM WHEN COMPOSITION OF COAL IS KNOWN


EVAPORATION FACTOR
100 103 106 109 112 115 118 121 124
LBS. OF WATER EVAPORATED
TEMPERATURE OF FEED WATER
212 202 192 182 172 162 152 142 132
12 11 10 9 8 7 6 5 4
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0 5 10 15 20 25 30 35 40 45
COST OF COAL IN CENTS PER 1000 LB. STEAM FROM AND AT 212°
NAME OF COAL
FIXED CARBON
VOLATILE
TOTAL COMBUST.
GEORGE'S CREEK VALLEY S-B MD. 71.9 19.2 94.1
MAMMOTH BED A PA. 86.4 3.1 89.5
POCAHONTAS R.M.5 S-B W.VA. 74.5 18.1 92.6
AVERAGE SEMIANTHRACITE PA 85.1 6.7 91.2
NEW RIVER DISTR4 S-B W.VA. 70.5 23.8 94.3
CLEARFIELD COUNTY3 S-B PA. 71.8 22.5 94.3
CUMBERLAND3 S-B MD. 73.5 16.7 90.2
CAMBRIA COUNTY3 S-B PA. 71.1 19.2 90.3
TIOGA COUNTY S-B PA. 67.8 20.5 88.3
SULLIVAN COUNTY S-B PA. 72.8 13.0 85.8
LYKENS VALLEY BUCKWHEAT A PA. 79.4 6.0 85.4
MASSILLON B O. 64.3 31.8 96.1
BRAZIL BLOCK #4 B IND. 63.0 32.5 95.5
JEFFERSON COUNTY B PA. 61.0 32.5 93.5
GANNEL BURG, DAVIESS Co. B IND. 58.9 34.4 93.3
YOUGHIOGHENY R.M6 B. PA. 58.3 34.1 92.4
COLLINSVILLE B. PA. 59.6 30.1 89.7
BRIER HILL B O. 57.7 35.5 93.2
JACKSON COUNTY3 B O. 55.0 34.1 89.1
CARNEGIE B PA. 55.1 37.8 92.9
PITSBURG3 B PA. 54.6 35.6 90.1
GREEN COUNTY B PA. 51.8 35.7 87.5
BRAZIL R.N. B IND. 50.3 34.6 84.8
LINTON (S CY) S/MI-BLOCK, R.M. B IND. 49.6 35.6 85.2
HOCKING VALLEY2 B O. 49.0 34.4 83.4
STREATOR, LA SALLE Co4 B ILL. 48.1 36.8 84.9
CENTERVILLE, APPANOOSE Co5 B IA. 47.5 36.2 83.7
PIKE COUNTY #5 5 B IND. 43.4 39.5 82.9
DUQUOIN, PERRY CO.14 B ILL. 47.5 34.5 82.0
CINCINNATI APPANOOSE Co3 B IA. 47.2 34.2 81.4
PEORIA #5 14 B ILL. 46.0 34.6 80.6
EDWARDSPORT #6 5 B IND. 43.4 47.7 91.1
ASSUMPTION, CHRISTIAN Co7 B ILL. 47.2 38.6 85.8
MACOUPIN COUNTY #5, 14 B ILL. 45.8 35.8 81.6
EVANSVILLE 4 B IND. 46.7 39.9 86.6
HITEMAN, MONROE Co. B IA. 44.7 37.6 82.3
DANVILLE, VERMILLION Co #7 B ILL. 46.0 36.6 81.5
CENTRALIA, MARION Co #6 B ILL. 44.3 36.7 81.0
WHATCHEER, KEOKUK Co. B IA. 43.1 35.0 78.1
CANNELTON, 8 B IND. 48.3 45.9 94.2
ANGUS, BOONE Co. # B IA. 44.4 38.5 82.7
PANA, CHRISTIAN Co. #6 B ILL. 42.8 35.8 78.6
BOONESBORO, BOONE Co. B IA. 43.7 48.0 91.7
SMOKEY HOLLOW, MONROE Co. B IA. 44.3 42.6 87.5
MARTIN COUNTY #14 B IND. 46.5 46.4 92.9
SEELEYVILLE #6 R.M. B IND. 41.8 38.0 79.8
SPRINGFIELD, SANGAMON #3, 16 B ILL. 42.1 37.4 79.6
MANASKA COUNTY-AVE- B IA. 42.9 41.4 84.3
DES MOINES, GIBSON MINE B IA. 43.2 40.6 83.8
VIGO COUNTY #7 B IND. 39.8 42.2 82.0
DES MOINES, MANBECK MINE B IA. 39.7 36.9 76.6
NUGHCHANOCK, SLACK B IA. 26.6 36.6 63.0
WHATCHEER, SLACK B IA. 26.6 32.7 59.2
BY PERMISSION OF
W. H. SCHOTT
ENGINEER
HARRIS TRUST BUILDING
CHICAGO

ber of methods used to determine these stresses and they are all known to be more or less inaccurate. This bulletin presents a more accurate method and demonstrates the inaccuracy of the methods in use, also presenting a new approximate method which is more exact than the present methods. The numeral values of the stresses are determined in a symmetrical 3-span bent 20 stories high.

Copies of Bulletin No. 80 may be obtained gratis upon application to C. R. Richards, Engineering Experiment Station, University of Illinois, Urbana, Ill.

ELEMENTARY MECHANICS FOR THE PRACTICAL ENGINEER, by J. P. Kottcamp; first edition, 181 pages, 85 illustrations; New York, 1915. Price, $1.50.

For the person lacking training either in advanced physics or pure mechanics, this little volume will impart considerable information and valuable training along that line. It is primarily an engineer's homestudy course.

The author's opening chapter deals with a consideration of Elementary Mechanics, followed by resultants of Force, Equilibrium, Law of Sines, Parallel Forces, Center of Gravity and a Summary of Conditions of Equilibrium, Machines, Friction, Kinetics, Motion, Work and Energy, with the subjects of The Inclined Plane, Projectiles, Rotary Motion, Centrifugal Force and Mechanics of Belting embodied in Chapters XV to XIX inclusive. Chapter XX, the last, is devoted to a general review of the preceding work.

An important feature of this book is the great care the author has taken to explain in the simplest terms possible every topic discussed, so that the reader is bound to obtain a clear idea of the subject in hand before attempting the following. Clear cut diagrams are freely used as a further aid, so that any one having a knowledge of elementary mathematics applied with a little patience and commonsense will be well able to follow each and every subject included.

As an aid to a thorough understanding of the important points brought out in the text, each chapter is concluded by the introduction of 5 practical problems followed by complete solutions.

Catalog Notes

INDEX FOR "National" Bulletins Nos. 1 to 20 of National Tube Co., Pittsburgh, Pa., contains in alphabetical order the subjects discussed in the bulletins, with the bulletin and page number of each.

THE FAMOUS oil filter, a combination oil refining and purifying apparatus with a completely enclosing heating jacket, is described in a pamphlet from the manufacturer, Famous Filter Co., of St. Louis.

REINFORCED CONCRETE chimneys, coniform and cylindrical, built by The Weber Chimney Co., 332 S. Michigan Ave., Chicago, are illustrated and described in Catalog 10.

CONDULETS Bulletin No. 1000C, including Bulletins Nos. 1000A and 1000B, has just been issued as a supplement to Condulet Catalog No. 1000 of Crouse-Hinds Co., Syracuse, N. Y.

FROM THE Titanium Alloy Manufacturing Co., Niagara Falls, N. Y., comes a booklet on Titanium aluminum and other standard bronze castings, giving the approximate composition of the company's various alloys.

AN EXPORT FIELD that has not in the past been given adequate consideration by American manufacturers—a field moreover of almost limitless potentialities—is that of India. That Empire, by reason of its vast population, its splendid (even if unequally distributed) resources, and the new wants created by the gradual development of modernity among an ancient people, presents to the American exporter a singularly attractive opportunity for the exercise of his commercial energy and acumen. It is a land where poverty exists by the side of almost fabulous splendor; where famine may succeed a time of plenty; where the intensity of tropical heat and the great rains of the monsoon cause strange conditions in the preservation and sale of merchandise; where religious beliefs or racial traditions may constitute the determining factors in the marketing of goods.

India, in 1913-14, imported from Germany and Austria-Hungary, respectively, $41,092,000 and $13,920,000 worth of goods. India has a population of 315,000,000, and an area of 1,802,192 sq. mi. Its imports in 1913-14 amounted to the enormous total of $594,517,000, of which the United States furnished only $15,542,000. The value of American products consumed annually in India is less than $0.04 per capita. Persons qualified to form an authoritative opinion believe that this should be very materially increased.

In an effort to stimulate interest in the Indian market and to emphasize the salient aspects of the trade, the Bureau of Foreign and Domestic Commerce has just issued a handbook of about 640 pages, dealing with the resources, industries, and commerce of India. This volume, which is regarded as one of the most valuable publications ever prepared by the Bureau, is entitled "British India" and is No. 72 in the series of Special Consular Reports. It may be obtained for $1 from the Superintendent of Documents, Washington, D. C.

STEAM BOILER EXPLOSIONS is the title of an illustrated lecture delivered at Cornell University by Wm. H. Boehm, of the Fidelity & Casualty Co., of New York. The lecture takes up the frequency of explosions, calculation of stresses in the girth and side seams, figuring of the bursting pressure, proper factors of safety to be used, the causes of boiler explosions, the effect of grease and scale on the boiler. The book may be had of the Fidelity and Casualty Co., 92 Liberty St., New York City, and it is, also, being sent out by the Committee on Uniform Standard Specifications, which is at present working for the adoption of the Standard Specifications as formulated by the boiler manufacturers and the American Society of Mechanical Engineers, as an argument for the need of standard practice.

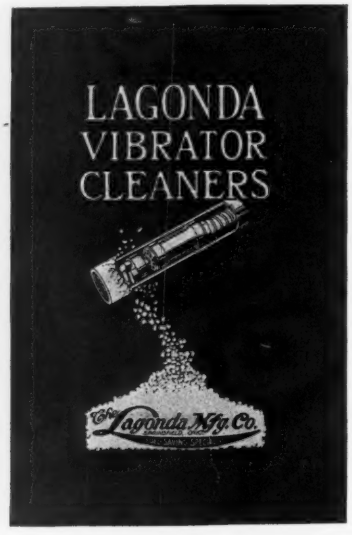
Another interesting booklet by Mr. Boehm takes up the question of flywheel explosions, showing their causes, how to determine the stresses in the rims due to centrifugal force, and how to determine the speed at which an explosion will occur, giving safe speeds for cast-iron, wood and steel wheels. This booklet may, also, be had from the Fidelity & Casualty Co.

FOLDER 4197-N, recently issued by the Westinghouse Electric & Mfg. Co., describes the various types of electric household helps manufactured by the company.

Leaflet No. 3760 describes and illustrates types EC and EH switchboards. These 2 types of switchboards consist essentially of the panels whereon are mounted the various indicating and recording instruments, etc., and the bus and switching equipments, which include all the separately-mounted switchboard apparatus.

Leaflets 3789 and 3790 are descriptive of Westinghouse Type C Semi-Magnet and Full Magnet Elevator Control. Both of these types of control are suitable for freight and passenger elevators.

LAGONDA VIBRATOR CLEANERS is the name of the latest catalog of the Lagonda Manufacturing Co., Springfield, Ohio. This catalog discusses the formation and removal of scale from fire-tube boilers, and describes and illustrates the new Lagonda vibrator cleaner, for



removing scale from fire tubes. The cleaner also loosens the soot on the interior of the tubes and it is blown out by the air or steam exhausting from the end of the turbine. The turbine used in this cleaner is the Lagonda high efficiency, high power, air or steam machine. A copy of this bulletin will be sent to anyone on request.

A RECENT ISSUE of The Travelers Standard, published monthly by the Engineering and Inspection Division of The Travelers Insurance Co., of Hartford, Conn., contains articles discussing the processes of barrel manufacture, value of annealing chains used for heavy work and methods for testing chains, and methods of guarding against ill effects of injurious gases and vapors from substances used in industrial processes.

BULLETIN NO. 47,050, recently issued by the General Electric Co., is devoted to that company's line of small plant switchboards made up of standard units in various combinations, providing for a great variety of conditions in small plants where panels of simple and inexpensive design are required. They are designed for 125 and 250-v., direct-current, 2-wire service, for general power and lighting purposes. These units are described and illustrated in detail, various combinations are illustrated, dimensions are given, and panels designated by catalog numbers. The publication contains wiring diagrams and a list of accessories.

SOUVENIR 25th Anniversary Bristol's Recording Instruments, a booklet from The Bristol Co., Waterbury, Conn., gives information about the company's exhibit at the Panama-Pacific International Exposition. A number of the illustrations are of demonstration models exactly as arranged in this exhibit, several of these being equipped for hand demonstration. The other illustrations give a general idea of the combined line of Bristol's recording instruments.

ATTENTION OF American manufacturers has been called repeatedly to the necessity of trade-mark registration in foreign countries, especially in those where priority of registration is the basis for ownership of a mark, and some American manufacturers have had the unpleasant experience of paying considerable sums for the right to use their own trade-marks which had been registered by their enterprising agents. While the Bureau of Foreign and Domestic Commerce has been interested for many years in the protection of American trade-marks in foreign countries, it is only within the last few months that it has succeeded in establishing a separate section devoted to the distribution of information in regard to trade-mark and patent laws in foreign countries. The issue of Tariff Series No. 31 is the first publication on the subject of trade-mark registration in foreign countries issued by the Bureau, and is intended to give American manufacturers an approximate idea of the formalities and cost of registering a trade-mark in Latin American countries, the fees shown being only those provided for by law, and do not include such expenses as attorneys' fees, postage, etc., which would naturally vary in specific cases. The Bulletin can be had from the Bureau of Foreign and Domestic Commerce, Washington, D. C.

THE INGERSOLL-RAND Co., 11 Broadway, New York City, has recently issued 2 new catalogs, forms 3031 and 4034. The former is descriptive of the new "Ingersoll-Rogler" Class "FR-1" steam-driven single-stage straight line air compressors. The catalog is profusely illustrated, showing the details of the machine in section. Among the principal features of construction may be mentioned the "Ingersoll-Rogler" air valves in the air cylinder and the balanced piston steam valve, with automatic cutoff control, in the steam cylinder. The air valves are silent in operation and long lived, operate entirely independent of any driving mechanism, and require practically no attention. The steam valve represents the most approved design, permitting the use of the highest steam pressures and superheated steam.

Form 4034 covers the Type No. 26 Leyner-Ingersoll water drill. This drill resembles the larger successful Leyner-Ingersoll drill, No. 18; it is, however, considerably lighter in weight and intended for smaller diameter and shorter depth holes.

Copies of both catalogs will be mailed free on request to the company's nearest branch office.

STREET LIGHTING BRACKETS and center span fixtures for Mazda lamps are the subject of Bulletin Y-679, superseding Bulletin Y-548 of General Electric Co.

A NEW BOOKLET, Dixon's Graphite Brushes, explains how the characteristic lubricating qualities of graphite are utilized in reducing commutator troubles, setting forth the advantages of graphite over carbon as a brush material. A copy of the booklet may be obtained free upon request, from the Joseph Dixon Crucible Co., Jersey City, N. J.

DESCRIPTIVE LEAFLET No. 3796, issued by the Westinghouse Electric & Mfg. Co., covers small direct-current generators known as type CD, ranging in capacity from ¼ to 2 kw., and 125 to 250 v. These generators are particularly adapted for use as exciters, charging storage batteries, lighting country residences and small industrial plants in localities where central station power is not available.

TWO PAMPHLETS from the Engineering Department of the National Lamp Works of the General Electric Co., Cleveland, Ohio, are Bulletins 23 and 24, the first devoted to Mazda lamps for projection purposes, taking up the science of the projecting lantern, and showing the proper adjustment and proper types of lamp to be used; the second devoted to outdoor tennis court lighting, showing the proper arrangement and intensity of illumination to make tennis courts available for evening play.

FROM THE S. Freeman & Sons Mfg. Co., of Racine, Wis., Bulletin No. 47, on horizontal return tubular boilers, has been received, giving a very complete description of the method of construction of the Freeman boilers, showing all dimensions in complete detail including horsepower, diameter of boiler, number, length and size of tubes, heating surface, thickness of shell and heads, grate area, diameter and height of stack required, and sizes for steam nozzle, safety valve, gage glass, water column, gage cocks, blowoff, and feed and check valves.

Illustrations are given showing the setting of the boiler with full flush front and with half front, giving, also, the details for a gallows frame support. Different types of grates are shown, and the dimensions given for the setting of the boilers, according to the latest practice, for both types, and, also, with dutch oven setting. Information is also given in regard to the full length vertical tubular boilers, vertical submerged tube boilers, and portable horizontal boilers. The catalog may be obtained by writing to the S. Freeman & Sons Mfg. Co., at Racine.

TELEPHONE BATTERY CHARGING by means of a mercury rectifier has been described in folder No. 4204-A just issued by the Westinghouse Electric & Mfg. Co. The construction of the rectifier is thoroughly described and illustrated, and the various component parts and the functions of each are clearly indicated.

TEXTILE QUARTERLY No. 9, issued by the Westinghouse Electric & Mfg. Co., is devoted to a description of the new pressed steel frame induction motor recently brought out by this company, and especially adapted for textile work. The method of rolling frames is described and illustrated, and other details of construction are carefully explained. The method of testing the motor against shocks and vibration is also explained and pictures are shown of the motor under test.

CENTRIFUGAL Blowers and Compressors for all pressures from 5 in. of water, as in mechanical draft service, up to 125 lb. per sq. in., as for compressed air distribution in mines, machine shops, ship yards, etc., are described in a 64-page book issued by the DeLaval Steam Turbine Co., of Trenton, N. J. The development of the high efficiency, high-speed centrifugal blower or compressor has been conditional upon improvements in materials, construction, shop practice and design such as are employed in the building of high grade steam turbines. By careful calculation of stresses, and by the use of good materials and workmanship, it is possible to run blower and compressor wheels safely and satisfactorily at peripheral velocities of 450 and 600 ft. per sec., which makes it possible to develop as much as 3 or 4 lb. per sq. in. pressure in a single-stage blower.

Numerous charts are given, showing curves for the isothermal, adiabatic and actual compression of air, also the theoretical power required to compress air and characteristic curves of single and multi-stage blowers and compressors. The influence of impeller design upon the form of the characteristic is discussed at some length. Particulars are given concerning the application of centrifugal blowers and compressors to forced draft, coal gas manufacture, coke oven plants and water-gas plants, sugar factories, cupola and blast furnace work, Bessemer converters, supplying compressed air in mines, ship yards, etc. The illustrations present numerous examples of blowers and compressors directly connected to steam turbines and to electric motors.

"SWITCHBOARDS FOR ALTERNATING CURRENT POWER CIRCUITS" is the title of Publication 1541-4-15, which has recently been received from the Westinghouse Electric & Mfg. Co., of East Pittsburgh, Pa. The subject matter of this publication was written by C. A. Sanderson and H. A. Travers for the Electric Journal, and has been revised and reprinted for this publication. The book contains 136 pages of the most recent information in regard to alternating current switchboards, illustrating and describing various types and sizes, also giving estimates for the cost of switchboard panels.

Trade Notes

SPRAY MFG. CO., recently incorporated for the construction of spray cooling systems, has changed its name to the American Spray Co., but will continue its former officers and will remain at the location 201 Devonshire St., Boston, Mass.

WE HAVE RECEIVED a letter from the Penberthy Injector Co., Detroit, Mich., calling attention to the recently published "History of the Panama Canal" and the fact that several Practical Engineer advertisers are on the "Industrial Roll of Honor" as participants in the greatest work ever undertaken by man.

On pages 366-367 is the following statement, which may interest readers, showing, as it does, the care exercised in the selection of even the smallest appliances used in this stupendous enterprise.

"As speed in the completion of the great work was an important feature in the calculations of the Canal Commission, it was sought, even in the smallest appliances to the machinery, to secure the appliance best adapted to the work it would be called upon to perform, and under the severe climatic conditions prevailing on the Isthmus. Many boilers were to be used in the various parts of the work, and it was sought to have every appliance necessary for continuous work of the most complete kind. In looking for an injector for supplying the boilers with water, the choice fell on that manufactured by the Penberthy Injector Co., of Detroit, Mich., because of its thorough automatic qualities, simple construction, and durability, operating with equal efficiency in any location or climate, excellent grading of the amount of water delivered to the boilers, and lifting water vertically 23 ft."

The book, by Ira E. Bennett, contains about 550 pages, and has as associate editors, John Hays Hammond, Patrick J. Lennox, William Joseph Showalter, Capt. Philip Andrews, Surgeon-General Rupert Blue, and J. Hampton Moore.

THE WESTINGHOUSE ELECTRIC & MFG. CO. reports the following orders as among those recently received:

Tug River Power Co., Sprigg, W. Va., one 1000-kw., 3-phase, 60-cycle, 2400-v., 3600-r.p.m. turbo-generator with direct connected exciter; 3 500-kv.a., O.I.S.C., single-phase, 60-cycle, 33,000-v. to 2300-v. transformers, and 21 single-phase, 60-cycle, 33,000-v. to 2300-v. transformers; Toledo Railway & Light Co., Toledo, O., one 20,000-kw., 3-phase, 25-cycle, 400-v., 1500-r.p.m., maximum rated turbo-generator unit, one 25,000-sq. ft. surface condenser with auxiliaries, and 2 2000-kv.a., O.I.W.C., single-phase, 60-cycle, 33,000-v., high tension to 4000-v. low tension transformers; Public Service Electric Co., Newark, N. J., one 1000-kw., 600-v., direct-current, 6-phase, 60-cycle, 900-r.p.m. rotary converter, 3 365-kv.a., air blast transformers, single-phase, 60-cycle, 11,000-v. high tension, rotary voltage low tension, one 350-kv.a., O.I.S.C., single-phase, 60-cycle, 60,000-v. high tension to 2000-v. low tension, testing transformer, one 350-kv.a., O.I.S.C., single-phase, 60-cycle, 2000-v. high tension to 440-v. low tension, regulating transformer, and one 2500-kv.a., single-phase, 6-cycle, 30,000-v. inductance coil; Northern Virginian Power Co., Worcester, Va., one 900-kv.a. alternator, vertical water wheel type, 3-phase, 60-cycle, 6600-v., 150-r.p.m.; Lackawanna & Wyoming Valley R. R. Co., Scranton, Pa., 5 200-kv.a., single-phase, 25-cycle, 22,000-v. high tension to 440-v. low tension, O.I.S.C. transformers.

THE VILTER MFG. CO., Milwaukee, Wis., reports the following among recent installations: The New Zealand Transport Board, Wellington, New Zealand, a 25-ton refrigerating plant; J. J. Nevin & Co., Wellington, New Zealand, a 10-ton refrigerating plant; Wm. Koch, Philadelphia, Pa., a 25-ton refrigerating plant; The Coffin Packing & Provision Co., Denver, Colo., a 2-ton refrigerating plant for its Grand Junction, Colo., plant; The Aluminum Goods Mfg. Co., Two Rivers, Wis., a 24 by 42-in. rolling mill type Corliss engine; The Phoenix Knitting Works, Milwaukee, Wis., a 20 by 36-in. rolling mill type left-hand Corliss engine.

PRACTICAL ENGINEER

Trade-mark, Reg. U. S. Pat. Off.

PUBLISHED ON THE FIRST AND FIFTEENTH OF EACH MONTH.

SEMI-MONTHLY

Subscription price in advance in the United States, Mexico or united possessions, $1.00 a year.

In Canada, subscription price, $1.75 a year.

Foreign Countries, subscription price, $2.50 a year.

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Quarter page, one year, each insertion, $20.00.

Eighth page, one year, each insertion, $12.00.

Front cover, $150.00 per issue.

Other specified positions, regular rate plus 10 to 50 per cent.

Stippled plates used, but no heavy, black and white plates.

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Per line, 30 cents each insertion.

Advertisements in this section are inserted under regular headings.

No display type allowed, but the first three words may be set in capital letters.

About nine words make a line. Minimum space sold, two lines.

Under classification "Position Wanted," advertisements not exceeding four lines will be inserted once for subscribers free of charge.

All copy should be received at Chicago office 18 days before date of publication.

Circulation of this issue, 22,500.

Technical Publishing Co.

537 S. Dearborn Street

Chicago

Position Wanted

POSITION WANTED—By young man with 10 years' practical experience from boiler room up. Hold first class Massachusetts engineer's license. Will go anywhere. Am total abstainer and can furnish A1 references. Address Practical Engineer, Box 393, Chicago, Ill. 8-1-2

POSITION WANTED—By young man, age 22, as oiler or helper in power plant. A. S. C. student. Sober. Good references. Address R. W. Peterson, 1041 S. Euclid Avenue, Oak Park, Ill. 8-1-2

POSITION WANTED—As chief engineer in small plant or assistant in large plant. At present holding a state position. Am capable of handling steam, electric and ice machines. Can do my own steam and water fitting and also all repairs called upon to do. Can give references. Willing to go anywhere. Address Practical Engineer, Box 397, Chicago, Ill. 8-1-2

POSITION WANTED—By engineer in medium sized power plant or helper in large one. Have third class Ohio license. 5 years' experience with steam engine and boilers. Some experience with electricity. Good habits. Sober. 25 years old. Good reference. Address Emmett R. Ralston, Box 43, Cheshire, Ohio. 8-15-1

POSITION WANTED—By engineer in medium sized power plant, or large coal mine. Have Illinois license; 7 years' experience with steam engines and boilers. Some experience with electricity. Good habits. References. 24. Illinois preferred. Address W. E. Rohline, Box 224, Farmington, Ill. 8-1-2

POSITION WANTED—By engineer with years of experience in ice and electric light plants. Understand both a.c. and d.c. machines. Am a graduate of one of the best colleges in Middle West. A1 references. Ezra D. Dumas, Clarinda, Iowa. 8-1-2

POSITION WANTED—Engineer, 47, New York; ambitious, with practical ideas, also technical experience. 7 years in charge in present position, wishes to make change. Position where economy and efficiency is appreciated preferred. Address Practical Engineer, Box 400, Chicago, Ill. 8-1-2

POSITION WANTED—By man of good habits. Age 30. Technical education. 12 years machinist and electrician, 2 years engineer, 2 years salesman. What have you? Address Practical Engineer, Box 401, Chicago, Ill. 8-15-1

POSITION WANTED—As engineer in small town. Have had thirteen years steam and electrical experience; practical machinist. James Doelzel, 3121 W. 26th St., Chicago, Ill. 8-1-2

POSITION WANTED—By young man as oiler or fireman in a modern plant. I. C. S. graduate. Address Frank Knapp, 404 S. 5th St., St. Joseph, Mo. 8-1-2

Help Wanted

WANTED—Resident subscription agents in the following cities: Atlanta, Ga.; Cincinnati and Columbus, Ohio; Kansas City, Mo.; Los Angeles, Calif.; Louisville, Ky.; Newark, N. J.; New Orleans, La.; Portland, Ore.; St. Louis, Mo.; San Francisco, Calif.; Washington, D. C. This is an excellent chance for a hustler, who is familiar with power plant conditions, to turn his spare time into dollars. To such a one we offer a Real Opportunity. Write Subscription Department, Practical Engineer, 537 S. Dearborn St., Chicago, Ill. tf.

WANTED—An operating engineer for an industrial power plant consisting of both Refrigerating Systems, Air Compressors, Belt Driven A.C. Generators, etc. Alternate shifts. Steady work. $120.00 to start. First-class chance for advancement. Location, northern Wisconsin. Address Practical Engineer, Box 399, Chicago, Ill. 7-15-3

FREE ENGINEER BOOKS and power plant tools and specialties for securing new subscribers to Practical Engineer. A dandy chance for the engineer with a little spare time to get some fine premiums. Send for free descriptive circular and terms. Address Practical Engineer, Subscription Department, Chicago, Ill.

ENGINEER—Good all around operating experience and pleasing personality for road work; no selling. $1500 to $1800 and expenses to start. Permanent. Applicants must be in or near Chicago. Apply The Engineering Agency, Inc., 1601-1662 Monadnock Block, Chicago. 7-15-3

REPRESENTATIVES to cover territory more thoroughly. Boiler-room necessities; liberal commissions; old-established house. Apply by letter. H. F. Maurel, 534 West 22nd St., New York City. 7-15-6

Wanted

WANTED—Agents to handle adding Pump Counters. Big commission paid. Address Box 302, Marshall, Minn. 7-15-3

WANTED—Agents handling engine and boiler-room specialties in every section for side line paying large commissions. Give experience, line carried, and territory covered. Address Practical Engineer, Box 381, Chicago, Ill. tf.

WANTED—Agents on commission to sell our Shaking Grates. We will install grates on trial or put in on test at our expense with any grate made. Address Armstrong Mfg. Company, Springfield, Ohio. tf.

WANTED—Experienced men to demonstrate and take orders for Pulle-Y-Grasp belt dressing during spare hours. Send for free sample and part. Cardinal Mfg. Co., Cleveland, Ohio. tf.

CHEMIST with experience as efficiency engineer in boiler house wanted. Good education and experience needed. State fully age, married or single and salary expected. Address Practical Engineer, Box 402, Chicago, Ill. 8-15-3

For Sale

FOR SALE—150-hp. HRT boiler, 4 yr. old, 125-lb. pressure, $400; 10 by 30 Hewes & Phillips Corliss engine, $325; 16 by 36 Fishkill Corliss engine, $500; 20 by 42 Watts-Campbell Corliss engine, $600; 125-kw. Crocker-Wheeler, 230-volt, direct-connected Allis Corliss engine, $1750; 50-kw. General Electric, 230-volt, direct-connected Harrisburg side-crank engine (one year old), $800. Duzets & Son, 50 Church St., New York, N. Y. tf.

FOR SALE—Gas Producer—150-hp. Smith, suitable for gas engine work or for industrial heating. A bargain. Syracuse Industrial Gas Co., Syracuse, N. Y. 8-15-1

Patents and Patent Attorneys

PATENTS—C. L. Parker, Attorney-at-Law and Solicitor of Patents. Patents secured promptly and with special regard to the legal protection of the invention. Handbook for inventors sent upon request. 186 McGill Bldg., Washington, D. C. tf.

PATENTS THAT PROTECT AND PAY—Advice and books free. Highest references. Best results. Promptness assured. Send sketch or model for search. Watson E. Coleman, Patent Lawyer, 624 F St., Washington, D. C. tf.

PATENTS—H. W. T. Jenner, Patent Attorney and Mechanical Expert, 606 F St., Washington, D. C. Established 1883. I make a free examination and report if a patent can be had, and the exact costs. Send for full information. tf.

PATENTS—Send sketch for free search and reports. Books on patents and book of reference letters sent free. John S. Duffie & Co., 612 F St., Washington, D. C. tf.

A. P. CONNOR, Consulting Electrical and Mechanical Engineer, Attorney-at-Law and Solicitor of Patents and Trade-Marks. Results guaranteed. 121 Carroll St., S. E., Washington, D. C. tf.-x

PATENTABLE IDEAS WANTED—Send for three free books. R. B. Owen, 28 Owen Bldg., Washington, D. C. tf.

Educational and Instruction

ENGINEERS' POCKET MANUAL; 175 pages; gilt edges; bound in leather; edited by University of Tennessee; will be mailed every subscriber sending in one NEW subscription (not your own) to Practical Engineer.

Miscellaneous

ENGINEERS, DO YOU WANT to utilize your exhaust steam for heating or drying purposes, without back pressure on your engine? If so, address Monash Engineering Co., 1413 W. Jackson Blvd., Chicago, Ill.

Inventions

INVENTIONS commercialized on cash and royalty basis. Inventors and manufacturers should write Adam Fisher Mfg. Co., 2175 Railway Exchange, St. Louis, Mo. tf.

Sparks From The Advertising Pages

A Convention That Benefits Every Subscriber

If you follow the advertising pages regularly, you have seen three full page advertisements in recent issues of Practical Engineer announcing the coming convention of the Federation of Trade Press Associations to be held September 7-8-9, in the Bellevue-Stratford Hotel, Philadelphia.

This is an annual affair—a "get-together" meeting held primarily to "get the other fellow's ideas" and to discuss ways and means of improving the trade and technical papers from the editorial and advertising standpoint.

Much has been said about the advantages of attending this convention, but let us view it from a different angle—Of what benefit is this convention to the subscriber?—You and the other fellow who stay at home.

The purpose of this organization, including 250 leading trade and technical journals and aggregating more than $40,000,000 invested capital, is to promote the highest standards of practice in the publishing business—to benefit you so that you will benefit its constituency—to wield a greater influence so as to yield a greater affluence in the commercial world.

A cursory examination of last year's proceedings proves this point and reveals topics discussed such as the following:

The Importance of The Technical Press to Engineers;
The Utility of the Business Press in the Conduct of Business;
The Educational Value of Advertising;
Putting Human Interest into the Business Press;
Educational Opportunities and Obligations of the Business Press.

A tentative arrangement of the program for this year's convention includes addresses and subjects equally as interesting as those above.

It is estimated that $37,000,000 in salaries is spent annually by the members of this association to give you what you want—and what you need in the development of yourself and your business.

The trade press is the voice of business expressing in irrevocable tones the progress of the day.

Are you getting all you should from your technical paper—Practical Engineer? Do you study it from cover to cover with text-book interest? It will richly reward you in tangible and imperishable wealth. Under its influence you will widen your possibilities and increase your opportunities—you will gain a front seat at the wide end of the horn of plenty.